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DIATHERMIC TREATMENT OF GIANT HOLES IN THE RETINA

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It is now generally known that the form of retinal detachment caused by typical disinsertion at the ora serrata (anterior dialysis) heals exceedingly well under proper diathermic treatment. This is the case even when the hole extends over more than one-fourth the circumference of the ora.

I have operated in the last five years in 100 such cases with 100 per cent success, and I therefore look on this condition as extremely well suited for diathermic treatment. It is not my intention to discuss here the reason for this happy outcome. I wish merely to point out that the prognosis of the operative treatment of retinal detachment, with the exception of disinsertion, is worse in cases in which large holes are present than in those in which there are small ones (not exceeding 2 disk diameters).

Although many other conditions may play an important rôle, detachment caused by small holes may sometimes offer more difficulties than detachment with relatively large ones (2 to 7 disk diameters); the results obtained show that, generally speaking, this rule holds true. An operation was performed in 147 cases in 1933 and 1934. A cure was effected in 20 cases of disinsertion and in all of the 17 cases of detachment caused by small holes, but in only 34 of the 44 uncomplicated cases in which there were large holes, mostly horseshoe-shaped, was complete recovery obtained.

Apart from the large horseshoe-shaped holes and the typical disinsertion in young persons, there are two other forms of detachment caused by "giant" tears that are generally looked on as so serious that practically no one operates on them; these are the traumatic form and the pseudodisinsertion associated with high myopia.

I do not share this opinion, and I shall report on some cases in which giant holes were treated with diathermy.

GROUP 1

In the cases in group 1 traumatic giant holes were caused by contusion. If the holes are peripheral and resemble a disinsertion, the prognosis is not unfavorable, although it is not nearly so good as in the cases

of spontaneous disinsertion. This is due to the fact that the holes are frequently multiple or complicated with severe hemorrhages or even with macular holes. Moreover, after some time star-shaped folds of the retina develop which have a marked tendency to prevent reattachment. If the holes are not of the disinsertion type, the prognosis is still less favorable, although not at all desperate, as is shown in the following case.

CASE 1.—N. C. K., a 45 year old man from Bombay, India, was sent to me by Dr. Banaji. On Oct. 27, 1934, the patient was struck in the right eye while playing water-polo. Several hemorrhages of the vitreous were discovered, and

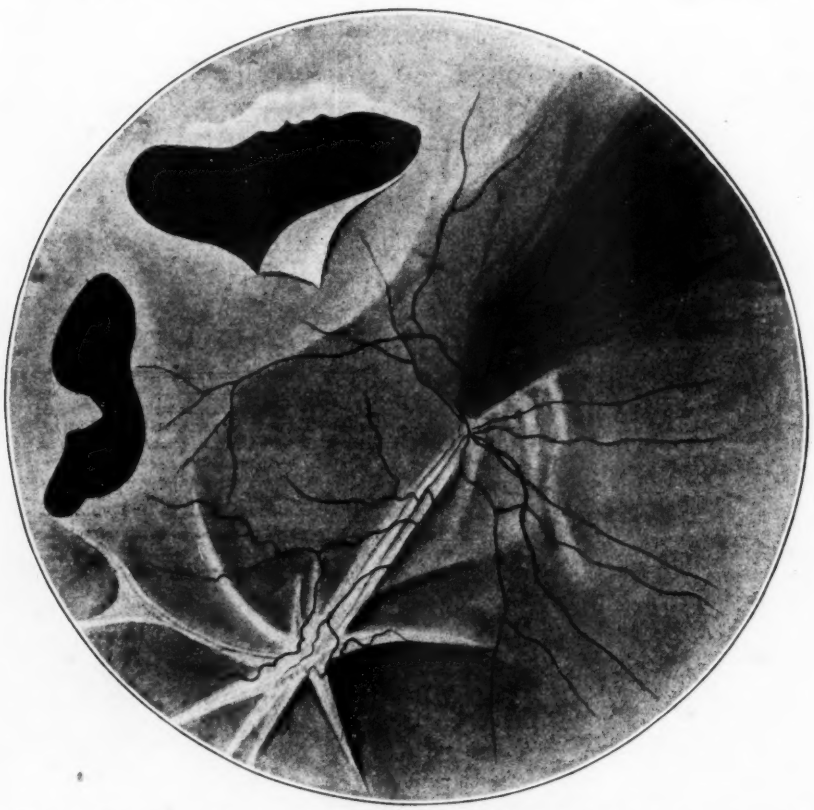

Fig. 1 (case 1).—The appearance of the fundus when the patient entered the clinic.

complete rest was ordered. On November 8 the hemorrhages were absorbed to such an extent that a detachment with large peripheral holes in the retina could be seen. The patient arrived at the clinic on Feb. 19, 1935, and at that time the fundus presented the picture shown in figure 1. The eye was slightly myopic, and vision was less than 1/10. The field of vision was strongly contracted, especially on the nasal side. The detachment was complicated with star-shaped retinal folds.

The first operation was performed on February 20. The holes and the center of the big star were localized by transillumination. The inferior and external

rectus muscles were divided at their insertion. Under ophthalmoscopic guidance surface coagulation was performed in the three marked areas. No change in the color of the retina was noted. Then the center of the star was perforated with a 1 mm. electrode, and other diathermic perforations were made along the margin of the hole without perforating the retina. On February 28 the retina seemed completely reattached.

On March 9 a relapse developed in that part of the temporo-inferior hole where it is joined by one of the folds of the star. A second operation was performed on March 14. The external rectus muscle was again divided, the surface over this part of the hole and over the center of the star was coagulated and perforations with a 1.5 mm. electrode were added. The retina was completely reattached on March 16. The field of vision was nearly normal. The patient left the clinic on April 20. Vision was then 1/10 after correction, and the eye continued to gain in vision, as Dr. Banaji wrote recently. It is to be noted that the fovea became detached four months before the first operation.

I have cited this example to show that even such large holes in cases of detachment of long standing and the formation of the starfolds are not contraindications for a successful intervention.

Another example of detachment caused by an extremely large, round hole (originally horseshoe-shaped) was observed in a case of detachment due to trauma associated with high myopia.

CASE 2.—S. d. L. was a 39 year old engineer. The right eye showed myopia of 24 diopters, and the left eye, 20 diopters. A tennis ball struck the left eye on July 20, 1935. Three days later the eye was completely blind. Several weeks later the patient consulted an oculist, who found total detachment of the retina but believed that an operation would be of no use. My opinion was requested. The patient arrived in Utrecht on November 15, four months after the onset of total detachment caused by an unusually large, round hole in the upper part (vertical meridian) of the eye (fig. 2). Vision was reduced to perception of light (1/300). The field of vision was reduced to a minute peripheral zone in the temporo-inferior sector. A sketch of the fundus was made, but the opacities in the vitreous, which made the drawing difficult, were not reproduced. An operation was performed on November 20. Two cubic centimeters of a 2 per cent solution of procaine hydrochloride with 2 drops of epinephrine hydrochloride per cubic centimeter was injected into the superior rectus muscle and into the surrounding tissue. After fifteen minutes 1.5 cc. of the solution was injected into the same area. A large incision was made in the conjunctiva parallel to the limbus at a distance of about 8 mm. The superior rectus muscle was divided at its insertion and refastened by the double spiral stitch of Lancaster to the sclera without the tying of a knot. By transillumination the contour of the hole was projected on the surface of the sclera and marked in ink. The most central part was found to be 25 mm. distant from the limbus corneae. A ring of surface coagulations at 80 C. was made along the margin of the hole. Next a ring of perforations was made with a 1.5 mm. needle electrode of platinum along the inner margin of the ring of surface coagulations. No changes could be observed with the ophthalmoscope. Only in the peripheral part was the margin of the hole coagulated. In the central part also perforating coagulations were made with an electrode of 3.5 mm.; three of the four punctures were well placed and caused marked coagulation along the margin of the hole, but the most central could not be seen. With a 4.5 mm. needle

a small but sufficiently large white coagulation was made in the most central margin. While these punctures were being made, much fluid was lost, but there were no hemorrhages. This may have been due to the fact that the punctures and the surface coagulations were made with the weakest current that could produce a sufficient effect and at such intervals that the temperature of the eyeball was raised only slightly. All instruments (forceps and specula) were properly insulated to prevent any diverting of the current. Two days after the operation the patient had a good field of vision for movements of the hand. Four days after the operation the first ophthalmoscopic examination showed complete reattachment

Fig. 2 (case 2).—The appearance of the fundus on Nov. 15, 1935.

of the retina. The patient remained in bed on his back for nineteen days. On the seventeenth day the bandage was removed, and Lindner stenopeic spectacles were used. (Usually these spectacles are given on the twelfth or fourteenth day and the patient leaves his bed on the fourteenth day.)

Figure 3 shows the ophthalmoscopic picture of the fundus one month after the operation. The field of vision is reproduced in figure 4. The central vision was 1/10 after correction of 20 diopters of myopia. If one considers that the vision before the detachment was only 1/300 and that the fovea was detached four months before operation, the result seems very satisfactory. Three months later the patient wrote that his sight was still improving.

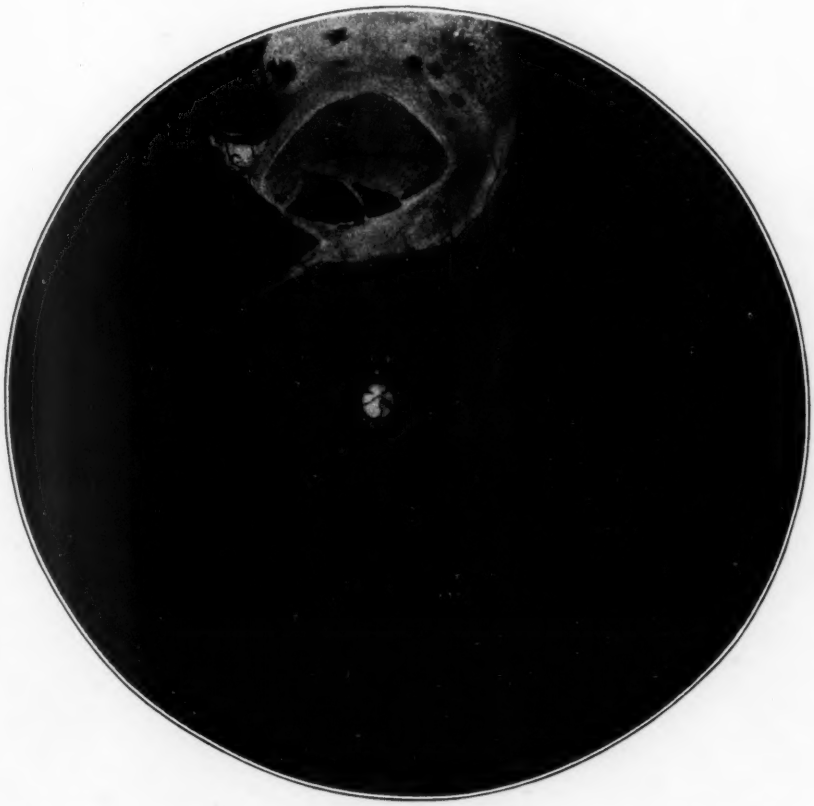

Fig. 3 (case 2).—The appearance of the fundus one month after operation.

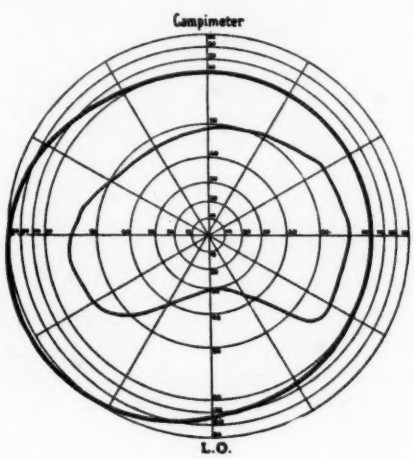

Fig. 4 (case 2).—The field of vision one month after operation.

GROUP 2

There is a second group of relatively rare cases of spontaneous detachment associated with high myopia caused by enormous holes imitating a disinsertion, though the clinical picture is somewhat different. It is my opinion that most cases, if not all, of so-called disinsertion associated with high myopia belong to this group. The condition is observed in children as well as in adults. Trauma is not essential, and the enormous hole that often reaches over half the circumference of the eye is formed not at the ora serrata but at some distance behind it. Often the condition can be verified only during and after operation, but in many cases it is observed ophthalmoscopically (figs. 5, 8 and 12) during the first examination. It differs in many clinical aspects from a true disinsertion. Though usually seen at the temporal part of the periphery, it is not confined to the temporo-inferior part and often extends to the superior quadrant. The most remarkable difference is that it is often accompanied with or followed by other holes near the pseudodisinsertion or in other parts of the eye. The development is acute, and often within some hours complete detachment occurs. In most cases it becomes bilateral after an interval of several years.

In contrast to true disinsertion, there is not the slightest tendency to spontaneous demarcation. While the detachment in cases of disinsertion usually has the character of a relatively flat, pellucid detachment, it rapidly becomes complete in cases of myopic pseudodisinsertion, and the retina may even turn over, showing its posterior surface, and may cover the optic disk, which is a rare occurrence in cases of true disinsertion.

Cystic degeneration, which I [1] have described in cases of typical disinsertion, is absent, but so-called cystoid degeneration (Iwanoff-Blessig type) may be present or may even be the cause of the hole (Vogt).

In my experience this condition is generally regarded by the ophthalmologist as being inoperable. I believe that one should never refuse to operate in these cases, as the eye is lost if an operation is not performed and the other eye will be attacked in due time. That these cases are not so incurable as seems to be generally accepted may be proved by the following three examples, the only cases in which I have had an opportunity to operate.

CASE 3.—E. A. was a farmer, aged 37 years, with high myopia. He was sent to me on July 31, 1933, by Dr. Sonnen, of Eindhoven, on account of detachment of the retina of the right eye. The left eye had been completely blind as a result of detachment when the patient was 2 years old. He had never worn glasses, and as he had never consulted an oculist before it is not possible to give the exact degree of the myopia. After recovery there was 14 diopters of myopia in the right eye. Figure 5 shows the appearance of the fundus when I first saw the

1. Weve, H.: Arch. f. Augenh. **109**:49, 1935.

patient. The vision was 1.5/300 without correction. The field of vision was confined to an eccentric sector in the upper temporal quadrant. There was an enormous peripheral pseudodisinsertion, with a hole temporally and with a horseshoe-shaped hole near the top. After five operations complete reattachment was obtained, with a surprisingly large field of vision and central vision of 2/60 with correction.

In January 1936 the patient wrote that his vision was much better than when he left the clinic. He again started his work as a farmer without difficulty. It is to be noted that he had his own little farm with no one to help him.

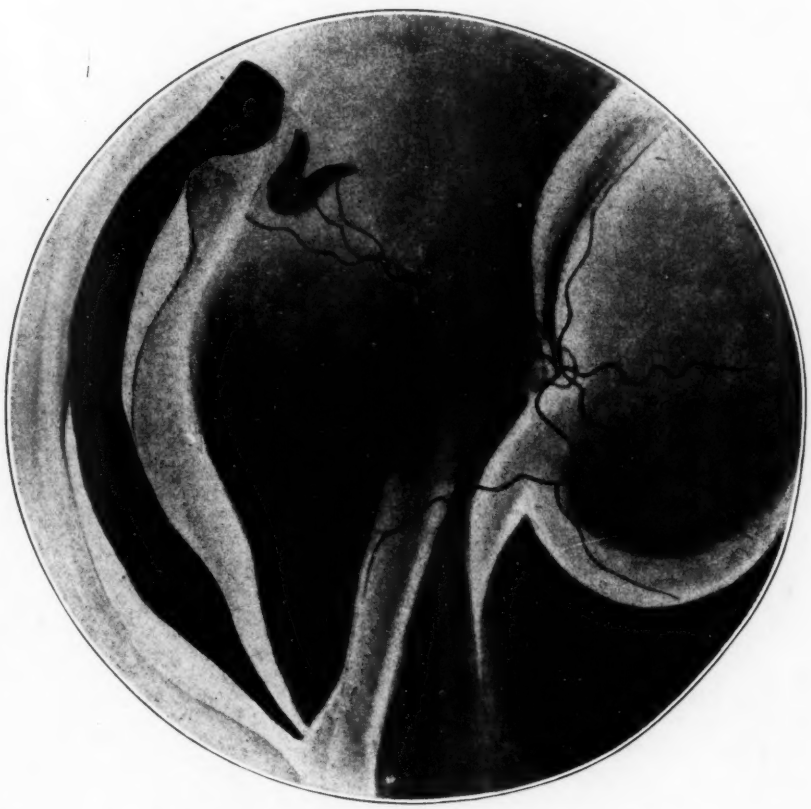

Fig. 5 (case 3).—The appearance of the fundus before operation.

The operation was performed on Aug. 1, 1933. After the instillation of 2 cc. of a 2 per cent solution of procaine hydrochloride and epinephrine an incision was made in the conjunctiva 13 mm. from the limbus over the temporal half of the eyeball, and tenotomy of the external and inferior rectus muscles was carried out. At a distance of 15 mm. from the limbus an arc of twelve surface coagulations was made from 7 to 11 o'clock (Enraf apparatus). Then a brush-shaped electrode of 5 mm. diameter (after the Šafář method, slightly modified) was applied to the sclera at a point corresponding to the horseshoe-shaped hole (localization by transillumination), the center being 17 mm. from the limbus. Finally a

series of perforating punctures were made with an electrode 1 mm. in length along the arc of surface coagulations on the central margin. The ophthalmoscope showed that the retina was in contact everywhere with the choroid, but no coagulation of the retina could be seen. Nevertheless the prognosis did not seem to be bad. The cause of the detachment was judged to be a peripheral hole in the lower part of the eye in the 8 o'clock meridian.

A second operation was performed, on August 21. The external rectus muscle was again divided. Šafář's brush electrode, 3 mm. in diameter, was applied in the 8:30 o'clock meridian. No result was obtained, and there was no loss of

Fig. 6 (case 3).—The appearance of the fundus several months after the fifth operation.

vitreous. The same brush, 4 mm. in diameter (both brushes had needles 1.25 mm. long), was applied, and a third application was made a little more peripherally, with rather marked loss of vitreous. The suspected area was well coagulated. The result was good, and the hole disappeared, but several weeks later it was noted that the detachment had extended. In the temopral part of the periphery, between 7 and 9 o'clock, part of the large hole was still open.

A third operation was performed, on October 18. In the area between 7 and 9 o'clock, 12 mm. from the limbus, surface coagulation was first performed, fol-

lowed by an arrow-shaped series of perforations with a 0.75 mm. electrode. The retina did not seem to be perforated anywhere, though there was a rather marked loss of vitreous. The retina was in good contact with the choroid and was well attached. The vision after correction was 1/6. The patient was discharged but two months later returned because of a relapse.

A fourth operation was performed, on December 27. The inferior rectus muscle was divided at its insertion. From the margin of the zone of the old coagulation a new curved line of surface coagulations, from the 4 to the 7:30 o'clock meridian, was made, followed by perforations at 7 o'clock with a 1 mm. electrode. There was much loss of vitreous. After this operation the retina was still detached in the lower nasal quadrant.

A fifth operation was performed, on Jan. 20, 1934. The presence of a new hole was suspected in the nasal periphery near the ora. Surface coagulation was made from the 3 to the 5 o'clock meridian, 9 mm. from the limbus, followed by a single puncture with a 0.75 mm. needle, without loss of vitreous. Nevertheless

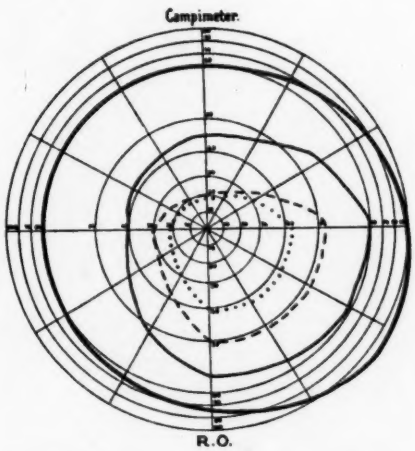

Fig. 7 (case 3).—The field of vision several months after the fifth operation.

a large cystic detachment of the lower half of the retina remained, beginning at the optic disk. In the course of the following months complete reattachment occurred, and there was a relatively large field of vision (figs. 6 and 7).

Five operations with corresponding long periods of immobilization with a bandaged eye seemed about the utmost that a patient should endure within five months. Much of the final success was due to his courage and confidence. I never felt more grateful for a successful outcome, as this man had just married and had started to care for a small farm when the detachment occurred in his only eye.

Equally interesting is the case of a 14 year old girl referred to me by Dr. Hazewinkel, of The Hague.

CASE 4.—M. B. had extreme myopia. The right eye was removed in 1933, when she was 12 years old, because of blindness due to detachment of the retina and a secondary cataract. The left eye had an atypical form of congenital cataract and myopia of 20 diopters. When the girl entered the clinic on July 17, 1934,

she had been four days without sight in the left eye. Detachment of the retina was seen to be caused by an enormous pseudodisinsertion (fig. 8). As this was her only eye, I operated on it the next day. After the external rectus muscle had been cut a crescent-shaped zone of surface coagulations was made from 6 to 11 : 30 o'clock, at a maximal distance of 13 mm. With the patient in a horizontal position the retina sank back more toward the choroid, and it was possible to make a better estimation as to the zone that should be coagulated. A surface coagulation was made at a distance of 20 mm. from the limbus, corresponding with the region of the round hole (fig. 8) seen near the optic disk. This hole was originally

Fig. 8 (case 4).—The appearance of the fundus before operation.

located near the equator and was localized by transillumination. In the center of this area a perforation was made with a diathermy needle that coagulated the hole in a most satisfactory way but failed to make it adhere to the choroid. A series of perforating punctures were then made along the crescent of surface coagulations. The retina came in direct contact with the choroid. As the loss of vitreous was great, the operation was completed only in the inferior and superior parts of the large disinsertion. The patient was kept in bed for a month with the eyes treated with atropine and kept bandaged. At the end of the first week nothing seemed to have been accomplished, but three weeks later the field of vision was much

enlarged, and a month later the inferior part seemed to be reattached. On September 2 the optic disk was visible for the first time. On October 14 the central vision had improved to 1/10 with a —16 sph. Figure 9 shows the appearance of the fundus at this time. Although parts were still detached (pellucida), it was clear that the enormous disinsertion was largely closed. The parents would not allow a second operation, so the patient left the clinic on October 28. Since then the eyesight has improved.

On Feb. 19, 1936, the patient was reexamined. The field of vision was remarkably large. Even the color sense had returned (fig. 10). The central vision after

Fig. 9 (case 4).—The appearance of the fundus three months after an operation was performed.

correction was 1/6. In the central part the retina was completely reattached, but in the periphery some local adhesions of the vitreous made cone-shaped localized detachments (fig. 11), presumably caused by invisible adhesions of the vitreous, as described by Gonin and denied by Vogt.

The next case shows that success has not always been achieved in the treatment of giant holes, especially if complicated with holes in other parts of the retina.

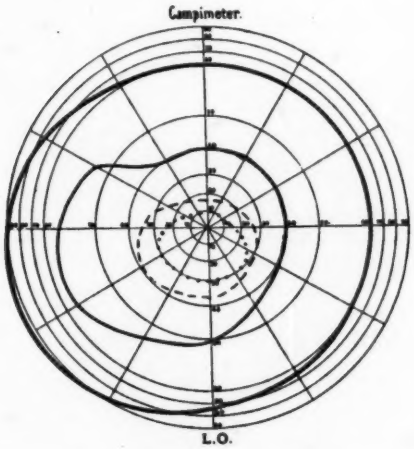

Fig. 10 (case 4).—The field of vision one and one-half years after operation.

Fig. 11 (case 4).—The appearance of the fundus one and one-half years after operation.

CASE 5.—The patient, a musician aged 28 years, was sent by Dr. Smit, of Dordrecht, on Nov. 6, 1935. There had been a gradual loss of sight in the left eye for three days. No trauma had been sustained. Vision was 1/4 (20 diopters of myopia). The nasal part of the field of vision was lost, and the temporal part was constricted. An enormous hole, reaching from 12 to 5 o'clock, was seen in the temporal part of the periphery. Two small holes were at 9 o'clock and three at about 7 o'clock (fig. 12). There was also a posterior staphyloma. The right eye had been blind for ten years as a result of detachment of the retina, secondary cataract, posterior synechia and atrophy of the iris.

Fig. 12 (case 5).—The appearance of the fundus before operation.

An operation was performed on November 7. An incision was made in the conjunctiva around the whole globe. The insertions of the external and inferior rectus muscles were cut and afterward refastened under transillumination. Superficial coagulation was carried out in the temporal half of the globe along the central margin of the large hole and along the peripheral margin. The same was done in the region of the holes at about 7 o'clock and at about 9 o'clock, directly behind and a little above the insertion of the rectus muscle. The holes in this part of the retina were first clearly seen during the operation, when they stood out against the detached retina. Three perforating coagulations in the center of

each of the fields of coagulation caused a moderate loss of vitreous and sufficient reattachment of the retina. All these holes were found at some distance from the ora serrata. On November 14 the retina seemed to be attached at all points. On November 18 the upper portion of the field of vision was restricted, and there were hemorrhages in the vitreous. On November 20 the vitreous contained so much blood that ophthalmoscopy was impossible. Tension was normal. With a small electric lamp the field of vision was restricted below and nasally. During the following week light perception was worse, but when the patient left on December 18 light perception seemed to have been restored in all parts, but ophthalmoscopy was still impossible. The tension was low, and a tendency to shrinkage of the bulb was apparent. The hemorrhages which occurred nine days after the operation prevented a successful result.

In this case a pyrometer of Pesme was used in order to make sure that the temperature of the electrode did not surpass 80 C. Nevertheless the necessarily

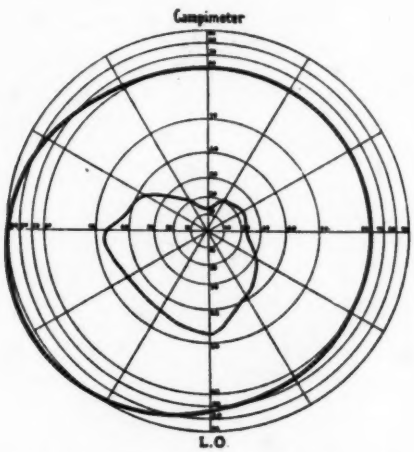

Fig. 13 (case 5). The field of vision three and one-half months after operation.

great number of coagulations and the great number of holes in all parts of the fundus seemed to be more than the eye could bear.

On Feb. 19, 1936, the patient was reexamined. Figure 13 showed the field of vision for hand movements. Ophthalmoscopy was still impossible as the vitreous contained large yellow masses. The tension was more nearly normal, and there were no signs of shrinkage of the bulb.

COMMENT

In all the cases described here I used the combined technic of surface coagulation, which I first described before the meeting of the Netherlands Ophthalmologic Society on June 1, 1930, and multiple perforating microcoagulations, which I described later in a monograph.[2] The combined technic of surface and perforating coagulation has been completely

2. Weve, H.: Zur Behandlung der Netzhautablösung mittels Diathermie, Berlin, S. Karger, 1932.

successful in the following cases: 72.5 per cent of 71 cases in 1933, 75 per cent of 76 cases in 1934 and 80 per cent of 133 cases in 1935. In at least 50 per cent of the cases the condition was complicated.

Two technical details were largely responsible for the success achieved: first, ophthalmoscopic control during the entire course of the operation and, second, the method of localization of the holes by transillumination.[3] The operator looks at the hole with an ophthalmoscope, and the assistant marks the center of the illuminated area on the sclera. A strong source of light, an inverted image and a lens of 20 diopters—in other words, indirect ophthalmoscopy with a stronger focal lens—are employed.

3. Weve, H.: Ann. d'ocul. **171**:1, 1934.

MEDULLATED OPTIC NERVE FIBERS ACCOMPANYING OXYCEPHALY AND OTHER CRANIAL DEFORMITIES

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Various ocular anomalies have been observed in association with oxycephaly. Medullated nerve fibers in the retina have occasionally been reported in cases of oxycephaly, usually, however, without any attempt at correlation. Ratner [1] noticed them in two successive cases of oxycephaly and for a time thought that there might be some correlation, but because they were absent in his next six cases of oxycephaly he considered their association merely coincidental. Metzger,[2] Kraupa [3] and Davis [4] each reported a case of oxycephaly in which medullated nerve fibers were present. However, they neither noted nor attempted to establish any correlation.

Medullated nerve fibers, on the other hand, have been reported to occur rather frequently in association with other anomalies and stigmas of degeneration. Kiso [5] reported six cases in one family, and in a review of the literature he found mention of four cases in which such fibers were associated with congenital syphilis. Fischer [6] observed medullation in four of twelve cases of Recklinghausen's disease. Ratner [1] reported medullation in cases of constitutional anomalies and of "hysteria." The occurrence of medullated nerve fibers has also been noted with other anomalies of the eye, such as heterochromia iridis (Cabannes and Sou-

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From the Neurological Service of Dr. S. P. Goodhart at the Montefiore Hospital and the Psychiatric Division of the Bellevue Hospital.

1. Ratner, J.: Ueber myelinhaltige Nervenfasern der Netzhaut und ihr klinisch-neurologischer Wert, Arch. f. Psychiat. **93**:235, 1931.

2. Metzger: Atrophie markhaltiger Nervenfasern im Augenhintergrund, Klin. Monatsbl. f. Augenh. **72**:801, 1924.

3. Kraupa, E.: Beiträge zur Morphologie des Augenhintergrundes, Arch. f. Ophth. **101**:333, 1920.

4. Davis, F. A.: Tower Skull: Oxycephalus, Am. J. Ophth. **8**:513, 1925.

5. Kiso, K.: Beiträge zur Kenntnis von der Vererbung der markhaltigen Sehnervenfasern der Netzhaut, Arch. f. Ophth. **120**:154, 1928.

6. Fischer, H.: Beitrag zur Recklinghausenschen Krankheit (Missbildungen am Auge besonders die markhaltigen Nervenfasern der Netzhaut), Dermat. Ztschr. **42**:143, 1925.

lard [7]), persistence of the hyaloid artery and coloboma (Leber [8]), amblyopia, alterations in the pigment epithelium and diminished light sense suggestive of a degenerative process (Reiger [9]). I have encountered

TABLE 1.—*Medullated Nerve Fibers in Cases of Oxycephaly*

Case Number	Age, Years	Sex	Type of Medullation	Type of Deformity of the Skull	Atrophy of the Optic Nerve	Other Ocular Findings	Other Associated Defects
1	40	M	Bilateral and massive about disks	Oxycephaly, roentgen findings typical	Absent	Bilateral exophthalmos; slight bilateral convergent strabismus; vision in right eye, 20/25; in left eye, 20/200	None; patient died of cardiac disease*
2	45	M	Small streak in left fundus near disk	Oxycephaly, roentgen findings typical	Bilateral and secondary	Bilateral exophthalmos; nystagmus upward and on right lateral gaze; vision in right eye, 20/20; in left eye, 20/15	High arched palate
3	43	M	Small patch over right disk	Oxycephaly, roentgen findings typical	Bilateral and secondary	Bilateral exophthalmos	Mental inferiority
4	19	M	Two patches at disk in left eye	Oxycephaly, roentgen findings typical	Absent	Bilateral exophthalmos	Epilepsy
5	61	M	Large patch at left disk	Oxycephaly, roentgen findings typical	Absent	Slight bilateral weakness of sixth nerve; nystagmoid movements	None
6	25	M	Large patch in right fundus at disk	Oxycephaly, roentgen findings typical	Absent	Bilateral exophthalmos	None
7	30	M	Bilateral large patches at disks	Oxycephaly, roentgen findings typical	Absent	Moderate bilateral exophthalmos	Mental defect; dysplastic build
8	47	M	Small patch in left fundus near disk	Oxycephaly, roentgen findings typical	Absent	None	None
9	55	M	Bilateral large patches at disks	Oxycephaly, roentgen findings not typical; no digital markings. Skull, high; sinuses rudimentary; orbits, shortened	Absent	None	None

* The eye and optic nerve were examined microscopically (figure).

7. Cabannes and Soulard: Cataracte et heterochromie chez l'enfant, Rec. d'opht. **33**:6, 1911.

8. Leber, T.: Die Krankheiten der Netzhaut, in von Graefe, A., and Saemisch, E. T.: Handbuch der gesamten Augenheilkunde, ed. 2, Leipzig, Wilhelm Engelmann, 1916, vol 7a, pt. 2, p. 2024.

9. Reiger, H.: Ueber einen Fall von markhaltigen Nervenfasern des papillomacularen Bündels mit hoher Myopie und Veränderungen in der Makula, Klin. Monatsbl. f. Augenh. **84**:517, 1930.

medullation in the eye of a patient who showed a vascular nevus in the distribution of the trigeminal nerve on the same side. Altogether, medullation of the optic nerve fibers in the retina is a moderately frequent anomaly. Various statistical studies estimate the incidence in the general population at from 0.03 to 0.24 per cent.

TABLE 2.—*Medullated Nerve Fibers in Cases of Deformity of the Skull Other than Oxycephaly*

Case Number	Age, Years	Sex	Type of Medullation	Type of Deformity of the Skull	Atrophy of the Optic Nerve	Other Ocular Findings	Other Associated Defects
1	3½	F	Small patch on left disk	Macrocephaly; roentgenogram showed convolutional digitations in posterior half of skull	Absent	None	Encephalogram showed congenital communicating hydrocephalus; retarded mental development, spastic tetraplegia
2	28	M	Bilateral small patches on disks	Macrocephaly	Absent	Bilateral exophthalmos	Obstructing hydrocephalus; spastic paraplegia; hypopituitary make-up, high arched palate; tendency to cleft uvula and palate
3	36	M	Moderate size patch at left disk	Macrocephaly, roentgenogram showed hydrocephalus frustes	Absent	None	Vascular nevus in distribution of left trigeminal nerve; facial hemiatrophy on the left; diabetes mellitus
4	47	M	Bilateral small patches at disks	Macrocephaly, secondary to hydrocephalus	Absent	Pupils fixed to light	Mental deficiency; spastic paraplegia (Little's disease)
5	54	M	Bilateral large patches at upper borders of both disks	Marked brachycephaly	Absent	Bilateral exophthalmos and ptosis; impairment of upward gaze movements	Inferior intelligence; evidence of congenitally defective nervous system; diabetes mellitus
6	53	M	Bilateral large patches at disks	Marked brachycephaly with tendency to trigonocephaly	Absent	None	Inferior intelligence; diabetes mellitus
7	58	M	Bilateral large patches at lower border of disks	Marked brachycephaly	Absent	None	None
8	40	F	Patch in retina separated from right disk	Marked dolichocephaly	Absent	Left enophthalmos	High arched palate; diabetes mellitus
9	28	F	Bilateral large patches at disks	Marked dolichocephaly	Absent	Moderate bilateral exophthalmos	None

In the study of fifteen cases of oxycephaly I have noted the presence of medullated nerve fibers in nine (table 1). It might also be stated that in addition to the aforementioned cases there were four cases of marked macrocephaly (in three of which the condition was definitely secondary to hydrocephalus), two cases of marked brachycephaly, two cases of marked dolichocephaly and one of trigonocephaly, in all of which medullation was present (table 2). Finally there were six cases

in which medullation was present in the fundus with no obvious signs of any abnormality of the skull. These observations were unusually frequent as compared with the figures given for the general population. This seems more than coincidental and warrants further consideration of the possible correlations.

COMMENT

Cranial Deformity.—Cranial deformity may be due either to an abnormally developing brain, as in congenital obstructing hydrocephalus, or to defective synostosis of the sutures of the skull. In cases of oxycephaly, as is well known, the deformity of the skull is probably due to an early premature synostosis of certain sutures of the skull, i. e., the coronal and possibly the sagittal sutures. Consequently growth of the skull transversely and anteroposteriorly is restricted. The tower skull is therefore due to compensatory increase in the height of the skull and represents the result of the effort of the brain to reach its normal volume. The orbits also suffer, the cranial cavity encroaching on them and shortening them anteroposteriorly. This probably explains the exophthalmos and restriction of ocular movements in cases of oxycephaly. In the process of premature synostosis in the early months of life the intracranial pressure is increased. This is evidenced in the roentgen picture, which shows the impressions of the cerebral convolutions on the skull, the thin calvarium, the obliteration of the diploe and the rudimentary sinuses. The last is probably the result of the same mechanism as the shortened orbits. Papilledema has also been reported in the early stages (Bedell [10]). Clinically oxycephaly is characterized by the disproportionate height of the skull, exophthalmos, divergent squint, nystagmus, ptosis, atrophy of the optic nerve, usually of the secondary type, with impairment of vision and even complete blindness, and restriction of ocular movements. The cause of the atrophy of the optic nerve is variously attributed to early intracranial hypertension (Friedenwald [11]), narrowness of the optic foramen or early meningitis.

Other abnormalities of the skull, such as marked dolichocephaly or brachycephaly, may in the same way be due to the early synostosis of the various sutures, that of the sagittal or of the transverse suture being responsible according to the deformity. In these conditions as in oxycephaly there may be transitory increases in the intracranial pressure before equilibrium is established. There are also associated distortions in the form of the orbits.

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10. Bedell, A. J.: Oxycephalus, J. A. M. A. **68**:1979 (June 30) 1917.

11. Friedenwald, H.: Cranial Deformity and Optic Nerve Atrophy, Am. J. M. Sc. **105**:529, 1893.

Development of the Optic Nerve.—Myelinization of sensory nerves occurs late in intra-uterine life and proceeds from the central nervous system to the periphery. Consequently at birth the fibers of the optic nerve in its orbital section are not yet medullated. Normally, within the first ten weeks of postnatal life they become medullated as far as the lamina cribrosa.

Lamina Cribrosa.—The elements of the lamina cribrosa are completely laid down at birth, when it is a thin and delicate structure of fibrous connective tissue. Since it supports the optic nerve in its passage through the scleral canal and is particularly important during movements of the eyes, it increases in strength and thickness with the increased movements of the eyes after birth (Haden [12]). It reaches its maximum development in adult life, at the age of from 20 to 30.

Medullated Nerve Fibers.—Certain animals, notably the rabbit, normally show medullated optic nerve fibers in the retina. At birth, however, none can be seen in the retina. They begin to appear on the tenth day and achieve full prominence in from two and a half to three weeks (Meyer-Riemsloh [13]). Myelinated fibers have never been found in the retina of new-born children because under normal conditions medullation is not complete until the ninth or tenth week. Therefore von Hippel [14] concluded that it cannot be a congenital anomaly but is an inborn tendency. He reported the occurrence of medullation in a child of 2½ years, one of the youngest patients in whom it has been observed.

The medullation in the retina is not continuous with the myelin sheaths of the optic nerve before it enters the retina. The myelin sheath is usually absent in the portion of the optic nerve passing through the lamina cribrosa and is reassumed at the edge of the disk and spreads out into the retina (figure). Gilbert [15] and Borello [16] described cases of defects of the lamina cribrosa in which the fibers pass unbroken through these defects. Occasionally the myelin sheath is reassumed within the disk just beyond the lamina. On the other hand, a patch of medullation is sometimes found in the retina separate from the disk

12. Haden, H. C.: Development of the Lamina Cribrosa, Am. J. Ophth. **8**:1, 1925.

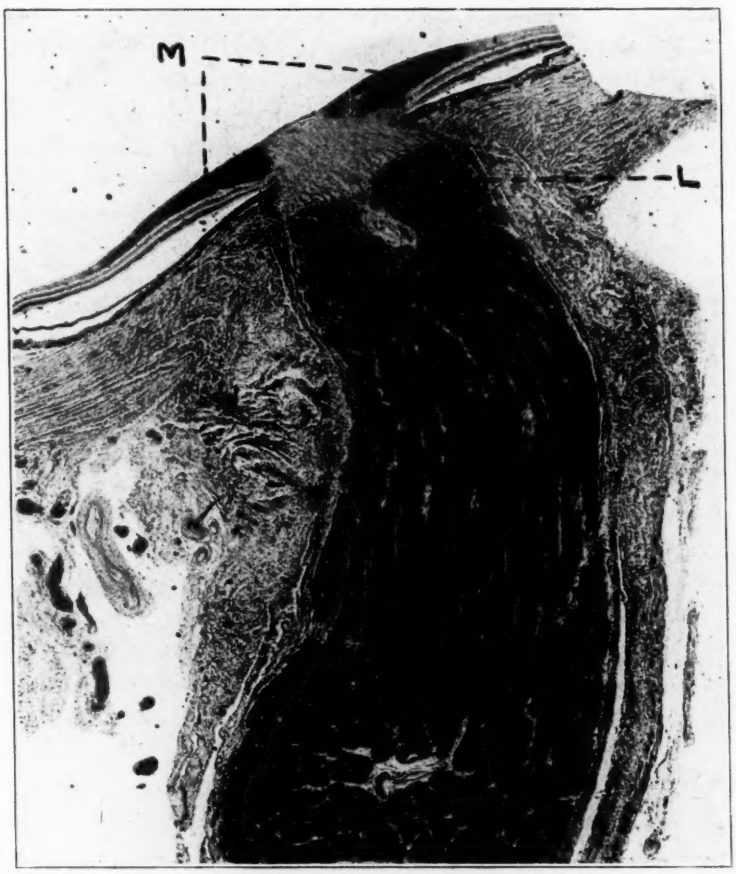
13. Meyer-Riemsloh, B.: Markhaltige Nervenfasern als erbliche Anomalie, Klin. Monatsbl. f. Augenh. **74**:355, 1925.

14. von Hippel, E.: Sind die markhaltigen Fasern der Retina eine angeborene Anomalie? Arch. f. Ophth. **49**:591, 1900.

15. Gilbert: Ueber markhaltige Nervenfasern der Papilla Optici Nervi, Klin. Monatsbl. f. Augenh. **42**:124, 1904.

16. Borello, F. P.: L'importanza della lamina cribrosa nel processo di delimitazione della parte mielinica ed amielinica nell'estremo distale del nervo ottico, Ann. di ottal. e clin. ocul. **54**:925, 1926.

(Nettleship [17]). When the opaque medullated nerve fibers in the retina are massive enough they may cause enlargement of the blindspot (Gradle [18]) and may even cover the macula so that vision is markedly impaired (Libby [19]). Leber found the incidence to be 82 per cent for unilateral and 18 per cent for bilateral medullation of the fundi. Another interesting and important fact is that medullated nerve fibers in the



Section of the optic nerve (case 1, table 1) through the papilla. *M* indicates medullated nerve fibers in the retina; *L*, lamina cribrosa. Weil's stain for myelin sheaths.

17. Nettleship, E.: Two Cases of Opaque Nerve Fibers in Retina, Tr. Ophth. Soc. U. Kingdom **20**:182, 1900.

18. Gradle, H. S.: The Blind Spot: III. The Relation of the Blind Spot to Medullated Nerve Fibers in the Retina, J. A. M. A. **77**:1483 (Nov. 5) 1921.

19. Libby, G. F.: Medullated Nerve Fibers Involving the Macula, Am. J. Ophth. **8**:713, 1925.

retina disappear if the optic nerve atrophies. Pflüger [20] ligated the optic nerve of one eye of a rabbit and after several months demonstrated ophthalmoscopically the disappearance of medullation in that eye. Clinically the disappearance of medullation has been reported to follow atrophy of the optic nerve in tabes (Wagenmann [21]), long-standing papilledema with secondary atrophy of the optic nerve (Nettleship [17]), glaucoma (Nettleship [17]) and embolism of the central retinal artery (Bachman [22]); Metzger [2] reported that it diminished in a 23 year old oxycephalic patient with descending atrophy of the optic nerve.

It is most likely that medullated nerve fibers are just another parallel mark of maldevelopment accompanying oxycephaly. It is a fact that part of the lamina cribrosa and the tissue involved in the synostosis both belong to the same embryonal layer, the mesenchyme. There may be a parallel maldevelopment of this layer in the skull and in the lamina. There is, however, the strong possibility that the condition is a sequential manifestation, i. e., a complication of oxycephaly or even other cranial deformities. To be so it is necessary that a defect or weakness in the lamina be present early in life, when myelinization is proceeding toward the lamina. Normal absence of the lamina cribrosa in the rabbit's eye explains its intraretinal medullation. Gilbert [15] expressed the opinion that in his case a defective lamina cribrosa accounted for the medullation. Leber expressed the belief that to hold the lamina accountable is hardly tenable and that medullation is a correlated anomaly rather than a complication of another anomaly.

Berliner [23] showed that in the rabbit's eye oligodendroglia cells are numerous among the myelinated fibers and absent in the portions of the retina that are lacking in myelinated fibers. In his opinion this observation supports del Rio Hortega's theory that the oligodendroglia cells are concerned with myelin formation and metabolism. Furthermore, the young oligodendroglia cells (oligodendroblasts) migrate by repeated division along the nerve fibers peripherally and linearly. The lamina cribrosa in man would then normally prevent the entrance of the oligodendroblasts into the retina. A defect in the lamina or a retardation in its formation might, according to Berliner, permit the

20. Pflüger: Ligature des nerfs optiques de deux lapins, Compt. rend. Cong. période. internat. d'ophth. **6**:48, 1881.

21. Wagenmann, A.: Schwund markhaltigen Nervenfasern in der Retina in Folge von genuiner Sehnervenatrophie bei Tabes Dorsalis, Arch. f. Ophth. **40**:256, 1894.

22. Bachman, R.: Schwund markhaltigen Nervenfasern in der Netzhaut nach Embolie der Art. Centralis Retinae, Arch. f. Ophth. **107**:10, 1921.

23. Berliner, M.: Cytologic Studies on the Retina, Arch. Ophth. **6**:740 (Nov.) 1931.

extension of the oligodendroblasts into the retina. Here they would perform their normal function, i. e., the elaboration of myelin around the axons. However, that the oligodendroglia cells have anything to do with the formation of myelin is not generally accepted, since such cells are found in both myelinated and unmyelinated portions of the central nervous system.

A consideration of the abnormal conditions existing early in the formation of oxycephaly offers a possible explanation for the cause of a defective lamina cribrosa in cases of this deformity of the skull. It may be that the early increase in intracranial pressure with papilledema strains the undeveloped lamina sufficiently to produce defects in it which allow the processes of myelinization to extend beyond the lamina into the adjacent retina. This is purely speculative, and I could find no report of a case of oxycephaly in the literature in which papilledema appeared early enough to coincide with the process of myelinization.

Since development of the lamina cribrosa probably depends on the movements of the eye I believe that it is possible that the restriction of ocular movements resulting from the shallow orbits of oxycephalic skulls predisposes to a retardation in the formation and development of the lamina from the beginning, i. e., at birth. Myelinization may then continue into the retina through the defective lamina cribrosa. Thus for a time the intraretinal medullation will be continuous with the medullation of the optic nerve proper. Ultimately, however, the lamina cribrosa, though retarded, develops. With the increase in its strength and thickness it severs the intraretinal medullation from that of the nerve, the bare axis-cylinders alone remaining in the lamina. I shall not attempt to make this a universal explanation of all medullated nerve fibers. This is merely another suggestion which seems plausible in cases of oxycephaly and perhaps of other cranial deformities.

Clinical Aspects.—That oxycephaly and medullated nerve fibers are not observed together more frequently is explained partly by the frequency with which atrophy of the optic nerve accompanies oxycephaly, as in Metzger's [2] case in which medullation which was present disappeared under observation owing to supervening atrophy of the optic nerve. In case 1 (table 1), on the other hand, there was no atrophy of the optic nerve, and the medullation was massive. In case 2 (table 1) there was a small streak of medullation that had apparently just escaped complete extinction by the atrophy of the optic nerve which was present.

The clinical value of the combination of oxycephaly and medullated nerve fibers lies in the fact that the obvious presence of one may suggest the presence of the other. In case 3 (table 1) the medullation was easily distinguished and prompted the more careful observation of the skull. On the other hand, oxycephaly was pronounced in case 2

(table 1), and ophthalmoscopic examination made specifically for medullation revealed a small streak which had been either ignored or overlooked on a previous examination.

SUMMARY

Medullated nerve fibers have been observed in nine of fifteen cases of oxycephaly and have also been noted in association with macrocephaly, brachycephaly, dolichocephaly and trigonocephaly.

Some possible explanations are suggested to account for the frequent association of medullated fibers of the optic nerve with the conditions discussed.

WILLIAM PORTERFIELD, M.D.

AN ALMOST FORGOTTEN OPTICOPHYSIOLOGIST

BURTON CHANCE, M.D.

PHILADELPHIA

> The Connection betwixt our Ideas and the Motions excited in the Retina, Optic Nerves and Sensorium is unknown to us, and seems to depend entirely on the Will of God, who causes these Ideas or Sensations of which the Motions in the Sensorium are only the occasional Cause, . . . The Mind does not itself produce our Sensations, and consequently they must be produced either by God himself, or some subordinate active Intelligence, according as the Sensorium is moved by Objects. . . . Sensation must therefore be produced by some immaterial active Cause, and consequently either by the Mind itself, or by the power of God, or of some other intelligent active Being acting under him.
>
> WILLIAM PORTERFIELD.

These are the musings of William Porterfield in an endeavor to comprehend the mysteries of the "Physiology of Vision," which no one yet had been able to solve for him, as he unreservedly set them down in "A Treatise on the Eye, the Manner and Phenomena of Vision," published in two volumes in Edinburgh in 1759—a remarkable and extraordinarily able work, far ahead of any other of similar scope then available in English. In it are theorems amply elucidating the problems of optics, many of which are held as good today and thus give evidence of the thoroughness of the author's powers of observation. Much, however, concerning sight was still beyond Porterfield's ability to explain, hence his reliance on "the active Intelligence of God himself."

Porterfield, a native of Scotland, was educated in Glasgow and then at Rheims, France, where in 1717 he received his medical degree. It is known that in 1724 he was a professor in the University of Edinburgh, and that he quite early manifested an interest in optics, and that in his later years he became a Fellow of the Royal College of Physicians at Edinburgh. Little is known of his life or even of his professional practice, the year of his birth and the date of his demise, and, at the last accounts, the place of his interment. I expect some time to receive further data concerning him from my friend Dr. Maitland Ramsay, formerly of Glasgow, who was able to supply a little information to Hirschberg for an account of Porterfield for insertion in his "History of Ophthalmology," in which a number of pages are given to the works of the Scottish oculist.

Read before the Section on Ophthalmology, College of Physicians of Philadelphia, Feb. 20, 1936.

The "Treatise" is an anatomicophysiologic exposition describing the structure and function of the organ of vision in both man and various animals, illustrated with drawings and diagrams. The author's reading in preparation was most extensive; he quoted from many authors writing in various languages and in all branches of science up to his day. Twenty years previous to the publication of the "Treatise" there appeared, in

A

TREATISE

ON THE

EYE,

The MANNER and PHÆNOMENA of VISION.

IN TWO VOLUMES.

By WILLIAM PORTERFIELD, M.D.
Fellow of the Royal College of Phyſicians
at *Edinburgh.*

VOL. I.

—Whence is it that Nature doeth nothing in vain, and whence ariſes all that Order and Beauty we ſee in the World?—— How came the Bodies of Animals to be contrived with ſo much Art, and for what Ends were their ſeveral Parts? Was the Eye contrived without ſkill in Optics, and the Ear without knowledge of Sounds? &c. NEWTON's Opticks, Query 28.

EDINBURGH:

Printed for A. MILLER at *London*, and for G. HAMILTON and J. BALFOUR at *Edinburgh.*

M,DCC,LIX.

Fig. 1.—Title-page of volume 1 of Porterfield's "Treatise."

"Medical Essays and observations revised and published by A Society in Edinburgh—Edinburgh 1737, and 1738," "An Essay concerning the Motions of the Eyes" in two parts, the first in volume 3 of the "Medical Essays," pages 160 to 263, "On their External Motions," and the second in volume 4, pages 124 to 294, "On their Internal Motions." The earlier "Medical Essays" became the basis of the "Treatise."

These communications consist of a consideration of all that had been published on the subject up to Porterfield's time and present a most lucid analysis of the propositions advanced by many authors and investigators. Both the "Essays" and the "Treatise" should afford entertainment as well as instructive reading to any one who has a knowledge of the accepted facts of physiologic optics. They show how the science grew from vague speculative reasoning to the deeper understanding of

difficult to abridge; and to transcribe all, would carry me far beyond the Bounds I had fixed to my self at this Time.

XII. *An Essay concerning the Motions of our Eyes*; *by* WILLIAM PORTERFIELD, M. D. *Fellow of the College of Physicians at* Edinburgh.

PART I.

Of their External Motions.

THE Motions of the Eye are either external or internal. I call *external*, those Motions performed by its four straight and two oblique Muscles, whereby the whole Globe of the Eye changes its Situation or Direction. And by its *internal* Motions, I understand those Motions which only happen to some of its internal Parts, such as the *Crystalline* and *Iris*, or to the whole Eye, when it changes its spherical Figure, and becomes oblong or flat.

In this Paper I shall only treat of its *external Motions*, reserving the *internal Motions* for the far more fertile Subject of another

nother Essay, which I intend to send you hereafter, If I find that your Readers have any Relish for such Enquiries.

The spherical Figure of our Eyes, and their loose Connection to the Edge of the Orbit by the *Tunica conjunctiva*, which is soft, flexible and yielding, does excellently dispose them to be moved this or the other Way, according to the Situation of the Object we would view. This Membrane is from its Situation also called *Adnata*. It takes its Origin from the *Periosteum* all round the Edge of the Orbit, and is extended over the whole fore Part of the Globe, till its Termination in the Edge of the *Sclerotis*, where it joins the *Cornea*. It is called *Conjunctiva*, from its Office, *quia oculum cum capite conjungit*.

This Membrane is covered externally with another Membrane: For, as is known to Anatomists, the internal Membrane of the Eye-lids, at the Edge of the Orbit, is turned forwards upon the outward Face of the Eye, and is co-extended over it with the *Tunica conjunctiva*, to which it is adherent.

These two Membranes, because of their close Union, appear to be only one, and are generally described as such under the Name of *Membrana albuginea*, so called, because they

Fig. 2.—A page from "Medical Essays and Observations" to show Porterfield's diction.

the visual function obtained from observations made in the passage of time by means of instruments and appliances invented for the objective study of the eyes as a whole as well as of all that was possible of the details of their structure before the development of microscopic investigation. The books are now counted as bibliographic treasures; only a few copies are to be found in the libraries of this country.

I can give only a brief reference to him to whom, for all time, ophthalmologic science is greatly indebted, one about whom so little is known and who is almost forgotten. There is time for only a superficial survey of certain of the chapters so ably and attractively presented in the "Treatise."

The historical outline which Porterfield gave of the development of description of the eyeball and of the orbital contents is indeed entertaining reading. He was much confused when he discovered in his pet cat, as it lighted on his knee, the presence and actions of the nictitating membrane. Because of failing sight he had mistaken that conjunctival membrane for part of the uvea; for a time he believed the variations in the aperture formed during the contraction and expansion of the membrane as it coursed over the cornea to be those of the deeper lying iris. He had laboriously studied the orbital structures and was much interested in the positions, courses and actions of the oblique muscles; he believed these muscles were connected with the membrana nictitans and were the source of its actions.

In the eighteenth century much attention was given to the subject of "after-images"; it was suggested that their production might be the result of fatigue of the retina, yet these and allied problems were generally regarded as beyond explanation. Porterfield well expressed the characteristic contemporary attitude in the passages quoted at the opening of my remarks.

Binocular vision was likewise explained in terms of theology, though Briggs, in his "Ophthalmographia," which he published in 1685, advanced the theory of "corresponding points" residing in each eye; to Porterfield, however, it was a "reflex of the soul." Nevertheless Porterfield suggested maneuvers by which a person might tell that he had lost the use of one of his eyes. Porterfield studied parallactic motions and offered ingenious means by which to ascertain "the reason why objects appear to move round the contrary way, and the persistence of moving images when the eye has come to rest after the objects themselves have come to a standstill."

The accommodation of the sight for different distances was believed to be impossible by observers up to the early years of the eighteenth century, and erroneous conclusions concerning that power were advanced by De la Hire and others; Porterfield, however, was able to correct many of those assumptions, and it is gratifying to learn from the researches of Donders and of Helmholtz, a hundred years later, that not a few of Porterfield's dicta were confirmed and have become accepted by learned observers.

It took a long time for the truths concerning the function to be revealed and to be appreciated; Porterfield was much occupied with the subject. Kepler, who was the first to recognize the necessity of accom-

modation, supposed that the effect is produced by a "shifting of the position of the lens." In this, the oldest of the assumptions, it was considered as probable that the position of the crystalline lens varied, the lens being moved to and fro during the act through voluntary contraction of the ciliary body. Such was Porterfield's belief. It was believed by others that the conformation of the eye was involved in the process, as by a lengthening or a shortening of the axes. This Porter-

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Conformation, that is neceſſary for ſeeing diſtinctly at different Diſtances, or ſuch as only reſpect the Dilatation and Contraction of the *Pupil*.

That our Eyes change their Conformation, and accommodate themſelves to the various Diſtances of Objects, will be evident to every body, who but reflects on the Manner and moſt obvious Phænomena of Viſion. It is now well known, and it has been demonſtrated, beyond all Exception, that when a Man views any Object, the Light which comes from its ſeveral Points is ſo refracted by the tranſparent Skins and Humours of the Eye, as to converge and meet again, at ſo many Points, in the Bottom of the Eye, and there to paint the Picture of the Object upon the *Retina*, with which the Bottom of our Eye is covered; which Picture being propagated by Motion, along the Fibres of the optick Nerves, into the Brain, is the Cauſe of Viſion; for accordingly as theſe Pictures are perfect or imperfect, the Object is ſeen perfectly or imperfectly.

Thus in general Viſion is performed; and to be convinced thereof, we need only take off from the Bottom of the Eye, a ſmall Bit of the *Sclerotis* and *Choroides*, and having, inſtead of them, applied the Membrane

and Obſervations. 127

brane of an Egg, or a Bit of oiled Paper, that the Humours may not eſcape; place this Eye at a Hole in the Window-ſhut of a dark Chamber, ſo as the Bottom of the Eye may be towards you; for you ſhall then ſee, through the Membrane or oiled Paper, the Pictures of external Objects lively painted on the *Retina*, with their proper Figures and Colours; only theſe Pictures will be inverted, juſt as it happens in the vulgar Experiment of the *Camera obſcura*, where the Images of external Objects are received upon a Sheet of white Paper, placed at a due Diſtance behind the *Lens*. But it muſt ſtill be remembred, that, according as theſe Pictures of external Objects formed on the *Retina* are more or leſs perfect and exact, the Object itſelf will be ſeen more or leſs perfectly and diſtinctly: For when the Rays that come from any Point of the Object are not exactly united upon the *Retina*, the Picture of this Point will not be a Point, but a Spot; which being confounded with the Pictures of the neighbouring Points, muſt render Viſion very confuſed and imperfect. We have an Example of this in the Eyes of *old Men*, whoſe Humours are ſo much waſted and decayed, that, through a Penury thereof, the *Cornea* ſhrinks and becomes leſs convex, and the *Cryſtalline* grows

Fig. 3.—Another page from "Memorial Essays and Observations" to show Porterfield's diction.

field denied, and many years later that fallacy was amply disproved when Thomas Young, in carrying out his experiment to prove that accommodation is accomplished not by an elongation of the eyeball but by changes in the surface of the crystalline lens during the act of accommodation, measured globes with his calipers.

In addition to these considerations concerning accommodation, Porterfield had observed repeatedly that the aphakic eye became incapable of performing that function, in consequence of which fact he

was impressed more and more with the idea that in the active youthful eye the important element in the process is the crystalline lens.

The connection now so well understood existing between accommodation and the convergence of the visual lines was definitely observed by Porterfield, although he judged the relation to be causal and absolute, and he maintained that a definite amount of convergence was accompanied by an equally definite degree of accommodative action, and that only beyond the limits of the range of accommodation could a greater or lesser convergence become possible, to which the amplitude of accommodation for both near and distance should correspond. It remained for Donders, a hundred years later, to tell that the accommodation can be modified without change of convergence.

Porterfield proposed to employ Scheiner's experiment for the measuring of the range of accommodation distances, and out of his study he designed an instrument which he called an "Optometer," with which he was able to explain the elements of that experiment. His invention was afterward improved and made more useful by Thomas Young.

As all remember, it was Mariotte who discovered a "blind spot" in the normal field of vision, yet Mariotte was unable to account for its presence. Porterfield, nevertheless, offered in explanation that this defect of vision is dependent on the position of the optic nerve in the fundus, and that the insensitiveness is due to the "want of softness and delicacy in the composition of the nerve." In this connection he further maintained that it is the retina which is the essential organ of sight, not the choroid, as Mariotte held.

I might go on for hours perusing these "Essays" and the "Treatise," but I must stop giving the details of the multitude of observations which Porterfield included in them as having been made by himself, or his comments on the investigations of others—the accumulated knowledge through the centuries.

He understood the processes relating to refraction and the common conditions of near-sight and far-sight as compared with the normal, yet he made no attempt to treat of the correction of these anomalies as they occurred in youthful subjects. Nowhere have I found a suggestion that their ametropia might be corrected by lenses and that by the wearing of spectacles the disabled ones might be relieved of the disorders of refraction, which disorders gave rise to complaints which were well known even at that day.

He did note the effects of uncorrected myopia on the mentality of the subjects, and he detailed the so frequently remarked psychologic characteristics of individual shortsighted persons. It was Porterfield who called attention to the greater size of the pupil in myopia, greater than what he had noted in normal persons, which wideness, he stated,

accounts for the increase in the circles of diffusion so constantly interfering with the distance vision of myopes.

He was aware that occasionally persons were found in whom the images perceived by the eyes separately were of unequal dimensions. Astigmatism was discerned; especially had he noticed it after the healing of ulcers and other losses of substance in the corneal membranes.

the leaſt Size it is capable of, upon ſeeing an Object confuſedly, that, on the contrary, it dilates conſiderably when the Light is faint and languid, even when the Object is confuſed and indiſtinct; and it is alſo evident, that the Contraction of the Pupil depends more upon the Strength of the Light than upon the Senſation of Confuſion in the Object; for the Pupil, which was pretty large when the Eye ſaw the Object confuſedly in the faint Light, contracts itſelf upon admitting the Light of the Sun, as well when the Object is ſeen diſtinctly, as when it is ſeen confuſedly.

And of the ſame Kind with this Experiment is alſo that which followeth: Place a Candle at ſuch a Diſtance from you, as that, when it is viewed in the Night-time, it may appear a good deal larger than it ought, becauſe it is too remote for diſtinct Viſion, and becauſe the Pupil is then much dilated, which muſt greatly increaſe the Magnitude of the Picture upon the *Retina*; if this ſame Candle be viewed in Day-light, or even if it be viewed by Night from a well lighted Room, or if a Flaſh of Lightning ſhould happen at the Time it is viewed, it will not appear much bigger than it ought, by reaſon of the Contraction of the Pupil, which corrects

corrects the Luxuriancy of its Picture upon the *Retina*.

This Experiment I noticed before; but as it ſerves to demonſtrate the Doctrine now before us, the Reader will forgive me for mentioning it again in this Place.

PROP. VIII.

§ 13. *The Pupils of both Eyes ſympathize with each other in their Motions, ſo that when the one Pupil is contracted, the other alſo contracts, and when it is dilated, the other alſo dilates.*

This is a fundamental Law in the Motions of our Pupils; the not conſidering of which, has been the Occaſion of many groſs Overſights and dangerous Miſtakes in Practice; as might eaſily be ſhewn, were this a proper Place for ſuch Digreſſions.

That the Pupils ſympathize thus in their Motions, will be evident from the following Obſervations: Let a Man, having a *Gutta Serena* in one of his Eyes, turn his Face to the Light, the Pupil of the diſeaſed Eye will not be found much enlarged, while the other Eye is open and expoſed to the Light; but if the whole Eye be ſhut, the Pupil of the diſeaſed Eye will dilate itſelf greatly: The Reaſon of this is evident; for when the whole

Fig. 4.—A page from Porterfield's "Treatise."

In speaking of the perception of visual impulses as the "Pictures are perceived on the Retina" he regarded that perception as

presented to all Parts of the Body, because the Sense of Feeling is diffused thro' all the Body; in some Cases behoved to be extended beyond the Body itself, as in the case of Amputations, where the Person, after the Loss of his Limb, has the same Perception of Pain, Itching, &c, as before, and feels them as if they were in the same Part of his Limb, tho' it has long ago been amputated, and removed from that Place where the Mind places the Sensation. Having had this Misfortune myself, I can the better vouch the Truth of this Fact from my own Experience; for I sometimes feel Pain and Itchings, as if in my Toes, Heel or Ancle,

&c, tho' it be several Years since my Leg was taken off. Nay, these Itchings have sometimes been so strong and lively, that, in spite of all my Reason and Philosophy, I could scarce forbear attempting to scratch the Part, tho' I well know there was nothing there in the Place where I felt the Itching. And however strange this may appear to some, it is nevertheless no way miraculous or extraordinary, but very agreeable to the usual Course and Tenor of Nature; for, tho' all our Sensations are Passions or Perceptions produced in the mind itself, yet the Mind never considers them as such, but, by an irresistible Law of our Nature, it is always made to refer them to something external, and at a Distance from the Mind; for it always considers them as belonging either to the Object, the Organs, or both, but never as belonging to the Mind itself, in which they truely are; and therefore, when the nervous Fibres in the Stump are affected in the same Manner as they used to be by Objects acting on their Extremities in the Toes, Heel or Ancle, the same Notice or Information must be carried to the Mind, and the Mind must have the same Sensation, and form the same Judgment concerning it, viz, that it is at a Distance from it, as if in the Toes, Heel or Ancle, tho' these have long ago been taken off and removed from that Place where the Mind places the Sensation.

If this should prove hard to be conceived, it may be illustrated by what happens in the Sensation of Colours; for tho' the Colours we perceive are present with the Mind, and in the Sensorium, yet we judge them at a Distance from us, and in the Objects we look at; and it is not more difficult to conceive how Pain may be felt at a Distance from us, than how Colours are seen at a Distance from us.

He held quite clear views on the perception of colors. He knew Newton's theories concerning the composition of light and the possibility of its decomposition, as well as the variations of the refractibility of the several component rays, their perception when received on the retina and, in addition, the complementary effects manifested during the persistence on the retina of the impulses of the individual rays. There was one other observation concerning "Color Vision" which he made; the text of his statement of it should be given exactly as he recorded it:

For to be persuaded of the Truth of what I have advanced, we must observe, that there is a great Difference betwixt our Sensations and the Cause of our Sensations. The Cause of our Sensations consists in nothing but certain Motions or Agitations excited in our Organs, and thence propagated to that Part of the Brain in which the Mind resides; but our Sensations themselves, or that which every one feels when he perceives an Object, are the Modifications of the Mind itself; which have nothing in common with the Motions in the Body to which they are connected; as for Instance, there is no necessary Connection betwixt any particular Colour, Taste, Smell or Sound, and the particular Motion in the Organs by which they are said to be excited; and therefore it is possible, that similar or like Motions in the optic Nerve of different Persons, may not give them the same Sort of Sensation, that is, make them see the same Colour. Thus the Motion which causes Redness in one, may cause the Sensation of green or blue in another, or even some other new Sensation, which no body before has ever felt or dreamed of.

In my researches in the bibliography of color vision, this is the earliest record of color blindness which I have found bearing the

imprint of the scientific observer. One may venture to surmise that Thomas Young might have read Porterfield seriously when he was making his own theories of the perception of color.

I wish to close this survey by quoting the "Conclusion" which Porterfield himself made to his "Treatise," for he expressed in it the consummation of his studies at the point at which he had arrived in their relation to the status of ophthalmology as a reasonable division in the science of medicine. It is worthy of quotation because it becomes a more or less complete objective delineation of what at the beginning of my discourse tonight was accepted as a metaphysical and spiritual conception of the causation and the manifestation of the visual function.

Thus I have finished the first Part of my Design, which was to explain the Physiology of the Eye; in which I have omitted nothing either necessary or useful, or curious and entertaining, that our Designed Brevity could easily admit of. I have examined the Structure and Use of its external Parts, and thence deduced the necessity of their different Conformations in different Animals. I have inquired into the Globe or Body of the Eye itself; and, for the better understanding its beautiful Œconomy, I have considered these six Things, 1mo, Its Situation in the Body; 2do, Its Connection with the Orbits in which it is placed; 3tio, Its Form; which is either spherical, as in Man, or spheroidal, as in several other Creatures; 4to, Its Number; which in Man is always two; but greater in some other Animals; 5to, Its Motions, which are wanting in some Animals; and lastly, Its Fabrick and Composition; than which nothing can be more beautiful or noble; every Part, however different in different Animals, being always such as best contributes to the Perfection of the whole. After this I have explained the Nature and chief Properties of Light, and from thence, and the known Fabrick of the Eye, I have deduced not only the true Manner of Vision, and the Use of the several Parts of this Organ, and also have accounted for the Necessity of its different Conformations in different Animals; and have shewn its Structure and Disposition to be always such as is best fitted to their Necessities of Life, and their Manner of Living. And lastly, I have, from the above established Principles, accounted for the chief Phenomena of Vision. From all which, every body may see, what a noble Piece of Geometry is manifested in the Fabric of the Eye, and the Manner of Vision. There is not one Part of the whole Body, that discovers more Art and Design, than this small Organ; All its Parts are so excellently well contrived, so elegantly formed and nicely adjusted, that none can deny it to be an Organ as magnificent and curious, as the Sense is useful and entertaining. Surely it cannot be said, without betraying the greatest Ignorance, as well as Impiety, that the Eye was formed without Skill in Optics.

Of what Use this Theory may be for understanding the Diseases of the Eye, and the Method proper for curing them, is too obvious to need to be insisted on: For want of such a Theory, the Diseases of the Eye have in all Ages been thought to have something very intricate in their Nature, and to require a Method of Cure quite different from all other Diseases: Whence, as HERODOTUS tells us, the ancient *Egyptians* had Persons set apart for treating these Diseases, who were not to meddle with any other: and even yet, which is very strange, and much to be regretted, notwithstanding the great Discoveries in Anatomy and Optics, their Cure is frequently committed to Pretenders to Secrets, and ignorant Empyrics,

who call themselves *Oculists;* but, being entirely ignorant of the Principles of Medicine, and particularly of the Œconomy of the Eye, the Use of its Parts, and the Manner of Vision, they ought never to be trusted with the Cure of such a tender and delicate Organ, wherein the least Mistake may be of the greatest Consequence; of which we daily meet with but too many Instances, when it is too late to help them. But the Diseases of the Eye have nothing intricate in their Nature; neither does their Cure depend on any other Principles, than those commonly employed on other Diseases, provided only due Regard be had to the Nature of the Eye, and the Use of its several Parts. And this ought the more to be here inculcated, because some of our ablest Physicians have not yet left off talking of Specific Medicines, as if there were some such, that are specifically appropriated to the Diseases of this Organ; whereas in fact, there is no such Thing: All Medicines for the Eyes operate the same Way as in other Diseases; whence the specious Title of *Specifics* ought always to be laid aside, as serving for nothing, but to nourish and cloak Ignorance, and the Method of Cure ought to be directed according to the general Indications taken from the preternatural State of the Solids and Fluids of the diseased Part. For the Body of Man is nothing but a curious Machine, whose Actions or Functions are the necessary Consequences of its Structure: It is composed of Solids and Fluids, which, so long as they abide in their natural State, all the Functions are regularly performed. But, on the contrary, when they are any way vitiated, then the Functions are lesed,[1] or which is the same Thing, a Disease ensues.

1. "Lesed" is Scottish for "damaged."

The Function of the Eye is Vision, and whatever hurts the Sight, is called a Disease; So that, to cure any Disease in the Eye, nothing is required but to restore that natural State and Condition to its Parts and Humours, from which perfect Vision does proceed.

The Conditions required for perfect Vision are indeed very numerous, as may be gathered from what has been said above, and therefore the Diseases of this Organ, or the Want of any one or more of these Conditions, must also be very numerous. To explain these Diseases in a rational Manner, and agreeable to the Principles I have laid down, and to point out a Method of Cure founded on Reason and Experience, is what I should now proceed to; but being heartily wearied with what I have already done, the Humour of writing will hold out no longer; and therefore I must delay this Part of my Design till some other Occasion, when I may be more at leisure, and more in the Humour of writing than I am at present, after the Fatigue I have had in compiling the above Theory.

FINIS

I must keep his explanation of "the Manner of Vision" for another time.

The advent of Porterfield and his works might be looked on as an outstanding episode in the history of medical science, a singular occurrence in the ophthalmology of the eighteenth century in England—a century in which quackery, charlatanism and plagiarism abounded, while in France, on the contrary, in the same century, orthodox practitioners were laying the foundations of modern clinical ophthalmology. Porterfield, in Edinburgh, and Thomas Young, in London, together with an increasing number of surgeons who studied ocular diseases intently

in the light shed by the contributions of the physical sciences, did much toward the founding of ophthalmology in England in following the example set by their neighbors in France, a planting which bore ripe fruits in the early years of the succeeding century.

It would have been a great boon had Porterfield prepared a work on the pathology of the eye with the thoroughness which he manifested in the treatise on the physiology, because in the eighteenth century there was no comprehensive work on the diseases of that organ. The first of the kind was that by the English surgeon James Wardrop, issued in 1808. But Porterfield's sight had failed, the loss of his leg must have sapped his vitality, and he was not able to follow out his intention, as no work entitled "Diseases of the Eye" coming from his pen has been discovered.

PERIPHERAL VISION IN ART

LLOYD MILLS, M.D.

LOS ANGELES

The value of experience is not in seeing much, but in seeing wisely.—Sir William Osler.

It is natural that the opthalmologist should develop an analytic attitude in regard to the visual capacities of artists and that he should search for evidences of normal and abnormal sight as revealed in their paintings. A scientific rendition of the visual truths of central and side vision is not to be expected. That knowledge is still largely the possession of the medical profession, but it was hoped that the uncanny instinct which is one of the significant endowments of the great artist would have produced pictorial evidence of the recognition of these natural forms of sight. Many great artists have shown occasional flashes of partial recognition of visual truth, but only in the genre work of Rembrandt and in that of the middle periods of Renoir and Monet have I found with any consistency an approximate graphic rendition of optical likeness which combines the qualities of central and side vision as the physician knows them. Even today in graphic art there is as little evidence of these properties of human eyesight as there was little or no evidence of perspective before Leonardo's time. Rembrandt recorded his instinctive reaction to actual visual experience, and in this way he stands unique among artists.

The principles of perspective lie at the base of all graphic art, but the area of central vision has been considered, and neglected, as a mere mathematical "principal point" instead of being made the most vital area within the whole visual field, as it actually is.

The representation, in painting on a plane surface, of objects as they appear to the eye has the difficulty of creating the illusion of various depths or distances which correspond to the positions of the objects. This effect of depth usually is achieved by differences in the size and detail of the objects and by the use of shading and shadow. The effect usually is heightened by the use of aerial perspective, overlay and accents and by reproduction of the effects which side vision creates on all objects, by which their edges are softened and colors modified, radial and tangential lines accentuated and actual linear distortion produced in the peripheral field. So long as these matters of artistry are carried out, no especial treatment is usually prescribed for the area of central vision. The general opinion that it is impossible adequately to

reproduce the sense of stereoscopic depth by the use of simple perspective is the result of neglect of this essential area and of failure to understand that this most vital of visual areas is vastly more than a mathematical point.

It remained for the impressionist schools to find and to develop the strong qualities and lovely attributes which lie in side vision, but in this research the sturdier virtues which exist in central vision were lost sight of—virtues which provide the contrast by which the ambient graces of side vision are made frankly evident and are intensified.

Of course, it may not be desirable to follow optical laws in posing a picture, and in the reproduction of photographic likenesses in general it is impossible to do so. But when characteristics and character are to be brought out, whether of persons or of things, the maintenance of correct optical values most effectively accomplishes this end. If, in addition, the use of artifice seems desirable, that is the artist's privilege.

Artists also should give serious consideration to the fact that, with the exception of the great examples of historical and photographic likenesses in painting, the few paintings which are acclaimed as outstanding works of art and which undeniably possess the qualities which artist and layman alike recognize as truly great almost without exception exhibit the normal relations of central and side vision. They rarely have required artistic subtlety for the rendition of compelling visual truth, but they show an area of central vision in its true proportion, with the correct subordination of the peripheral field. When the acknowledged best works of all the great artists are studied, it will be seen that when they are at their greatest they most nearly and clearly exemplify the true limits and qualities of these two forms of vision. Rembrandt's "Landscape," in the Gardner Collection, Boston; Turner's "Rain, Steam and Speed," in the National Gallery, London; Homer's "Cannon Rock," in the Metropolitan Museum, New York, and Israel's "The Day before Parting," in the Boston Museum of Fine Arts, exhibited by Ames as well-nigh perfect examples of depth in pictorial art, are nearly mathematically exact instances of correct visual areas, with equally correct subordination of the peripheral field.

Regardless of how much the effect of depth may be built up by artistry and artifice, no painting will achieve greatness in which the laws of the true proportions and optical relations of central and side vision are not closely followed.

The outstanding quality of Rembrandt's work, when he was not employing photographic detail for historical record, was his excellent handling of the area of central vision and his almost mathematically correct subordination of the peripheral field, a treatment by which every demand of correct vision, as seen at one attentive look, is fulfilled. In his portraiture he carried this art to its highest peak. His "Portrait

of the Painter," 1663, in the Lord Iveagh collection and his "Self-Portrait" in the Andrew Mellon collection at Washington, D. C., are perfect examples of correct handling of the central area of attention. His frequent use of chiaroscuro and his arbitrary lighting effects justly may be attributed to his desire to subordinate areas of side vision to areas of primary visual and emotional importance. This subordination gives his canvases their remarkable sense of depth, without the use of overlay, accents or aerial perspective.

Although there is relatively little evidence in art of the combination of central and side vision as it is found in the human eye, central vision, of course, always is used in the sharp delineation of detail. When this delineation covers a whole canvas, it becomes a photographic, not an optical, likeness and is contrary to human experience. This explains why paintings having much detail often are unsatisfactory when viewed from a distance and prove tiresome on prolonged acquaintance. So also do too strong flavors, too sharp odors and too violent emotions.

Painting with photographic detail has had a high and worthy place in historical and decorative art, however, and in the forms of portraiture in which exact facial and sartorial records have been desired. It never is optically correct even when pleasing. Exact records of the splendors and customs of past generations, which are of much human interest and value, have been made available to the present generation chiefly through this medium. The discovery and development of photography have nearly eliminated this form of painting save for murals, and with the introduction and perfection of the colored film, painting of photographic likenesses easily may become a curiosity if not a lost art. Collectors please note!

Although the search for the rendition of true optical likeness has borne little fruit, attempts at the pictorial presentation of side vision were found to be extensive, especially in recent years. This form of painting was first employed by the early impressionists, who appeared above the artistic horizon in 1874, and its use was in the nature of a quiet but definite revolt. This period had been preceded by a long area of full-blown victorianism, during which the artistic expression of the empirical times ran true to form and a return to classicism and to an extreme of imitative realism had become the vogue in painting. Its highest expression was the production of likenesses in photographic detail, prettified to capacity and based generally on mythologic, poetic, sacred or historical themes. The limited methods by means of which these stilted subjects could be picturized gradually exhausted artistic invention and led to the final lowering of all art to the dead level of mediocrity.

The war of 1870 was equally disastrous to Germany and to France in its finalities. The bitter completeness of their unexpected humiliation

shocked the French into a revolt of political and social ideation, a revolt willingly shared by all the arts, which for some time had been straining for release from the petrified formulas of realism. Corot and Millet already had broken away. Courbet's experimental work on light and atmosphere had inspired such great artists as Manet, Monet, Renoir and Whistler, and in 1863 Monet, Renoir, Bazille and Sisley definitely forsook the classic style. The impressionist school of 1874 was the first real flower of this reaction, and from that time to the present France has maintained her leadership in art. The small group which formed this school were, for the most part, soundly trained, sincere artists, who deliberately began the study of the effects of light on color and the color of shadows and made early but seldom bizarre excursions into the field of artistic idealism.

Claude Monet, the genius of this artistic revolution, was the first impressionist, the first deliberate French painter of light in its endless transformations and the first French painter to understand that shadows actually are combinations of color, in which any tone may predominate under given conditions.

Girtin, the young English friend of Turner, was the first artist to break with the classic method of painting shadows brown or black. Turner followed Girtin's style, and Monet, who visited England with Pissarro in 1870, not only followed Turner's lead but drew his inspiration for light and color and the technical basis of handling it from Turner.

In spite of Constable's earlier innovation of painting in the open air, it was still the fashion to paint indoors and not to attempt to reproduce the actual appearance of any scene. The artist made a slight sketch and a few notes on color and within his studio shifted mountains, valleys, lakes, streams, architectural details and colors to suit his fancy. Light was suggested but never was painted. Monet, who like Constable defied convention by painting in the open, was also preeminently a painter of landscapes. His extraordinary powers of vision were directed and coordinated by the capacity of genius for detailed observation. At the age of 30, he was attempting to portray optical likenesses, but without understanding either his exact aims or the methods of obtaining them. It is probable that he was never more than superficially aware that the qualities which make for correct landscape painting are inherent in the peripheral vision of man. The facts of sight, and specifically the truths of central and side vision, were then unknown, and it is a tribute to the intellectual honesty and genius of the man that his portrayals of visual truth often so nearly approached perfection. His feet were set solidly on the path when he learned from Turner that the desired brilliance, dulness or tone of color could be obtained by dabbing spots or small parallel touches of different colors in close

juxtaposition. These different colors, chosen according to the desired effect, merged into the natural color when seen at a distance. Monet extended this simple principle of light with a patience and precision of observation wholly scientific in its character. He observed and stated the theory of complementary colors and painted the first examples of its application, and he gradually brought about "the complete interfusion of drawing and coloration by accumulated touches of pure color, disposing them in due perspective and modelling them with the point of his brush; touches, spots, irregular dabs, confidently dashed on. The colored planes were only treated as values of greater or less density, the contrast of which produces form."[1] The analysis of shadows was one of the most important of his achievements.

The swing from classicism by this time had sent the impressionists toward the other extreme, and they were choosing the commonplace, the simple and, at times, the ugly for artistic interpretation. Monet at this time also had just discovered the color engravings of the Japanese master Hokusai, in which genre subjects were treated with the dignity, loveliness and perfection of design which hitherto had been reserved exclusively for classic themes. The influence of Turner's treatment of color and of Japanese design and selection of subject was carried into this eager group by Monet and became the actual basis of impressionism and of the later neo-impressionism.

Monet towers so far above the other artists of his day and his influence on modern painting has been so great that it is unfortunate that there are no records of the exact condition of his eyes.

A considerable percentage of all painters are myopic, and few who use their eyes to such extremes as do artists are spared defects of vision. The person with defective vision depends much more on side vision than does the person with normal sight. Impressionism actually is the picturization of objects or scenes as perceived by side vision, used either deliberately, as Monet apparently employed it, or of necessity, as in the case of Cézanne and others, because of uncorrected errors of refraction and, especially, of myopia. Impressions and not details are derived from side vision alone, and in this sense impressionism has a necessary place in every work of graphic art and all attempts to elaborate it into a complex theory of esthetics are wasted effort. Mauclair correctly stated that "impressionism is a landscape art," but the reason for this he did not define or know. Monet expressed the accurate use of side vision in depicting "the expression of light, of air, of movement and of the unceasing changes" which are continually taking place in the realm of side vision, with a consistency not approached by any other artist of that period.

1. Mauclair, Camille: Claude Monet, translated by J. Lewis May, New York, Dodd, Mead & Company, Inc., 1924.

The name impressionism arose from Monet's painting *"Impression. Soleil levant,"* exhibited in 1874, and seldom has a name applied in jest been more fully appropriate and explanatory.

Even the best landscape painters rarely have been sufficiently observant of the actual visual facts to portray or even to suggest the constant presence of a small central area of a greater degree of detail or of heightened interest, so intent have they been in painting form, color, motion and light. Probably the fact that most landscapes are sketched outdoors and are built up from memory and finished indoors accounts for part of this loss of visual accuracy. The technic of the impressionists, however, was to obtain impressions by fleeting glances, and, as it obviously was impossible to perceive details by such a method, central visual details and the central area of interest or attention, which must appear in all true optical likenesses, were rejected. Details of form, which require direct attention, also for the most part were suppressed deliberately and merely were suggested. Monet rarely if ever used the normal central area of maximal visual clarity given by normal central vision. His visual observations otherwise are so true, however, that it is likely that he had a moderate degree of myopia, sufficient to make easy the recognition of the values lying in side vision and enough to give his landscapes the characteristic concubinage of blur, modification of color and persistence of the essential lines and contours which are the essence alike of normal side vision and moderate myopia. The same result would follow the rigid use of the technical impressionistic formula already given.

Attention is drawn to the problem of myopia among artists because of its frequency, because of its probable influence on the visual pattern of impressionism and because the myopia from which Cézanne suffered and his deliberate use of peripheral vision gave the distortional pattern for neo-impressionism. I believe that uncorrected myopic vision has produced marked effects on contemporary art, which should be recognized and given all the honor which sincere endeavor deserves. But this pattern should not be held as an artistic norm or idealized in any sense. A careful analysis of the recent baroque art should identify without much difficulty the artists who sincerely painted objects as they saw and idealized them with defective eyes and those who had other sources of motivation.

Myopia is a disease of the eyes which usually begins in childhood, at the time when eagerness for knowledge is becoming manifest. It often appears to be hereditary and nearly always is in relation to high mental speed, intense aspiration and the severe competition and heavy mental stresses of civilization. The condition is exaggerated by long hours of prolonged visual application under poor light and by general poor hygiene. The proportion of myopia is much greater among the

educated, of whom possibly one person in twelve is myopic, although in countries like Germany, where schooling is exceptionally severe, the proportion is higher. In vocations demanding exceptional use of the eyes, such as art, the proportion is higher, being 48 per cent among artists in my practice.

In myopia the eye becomes long; the walls stretch, and all the coats, including the retina, become thin. Changes may occur in the axes of inclination of the lens, and the fluids which fill the cavities of the eye always contain floating opaque matter, which interferes with perfect transparency. Glasses correct the optical defect, but when impressionism began glasses seldom were used for that purpose, and even today it is notorious that in continental Europe it still is considered a reproach to wear glasses of any kind in public, regardless of the degree of visual defect.

The effect of myopia is to limit the range within which objects may be seen clearly from a few inches to a few feet from the eyes, depending on the degree of the defect. Beyond this far point all vision is peripheral; details are lost; essential lines and contours relatively are more striking, although objects generally are blurred; the recognition of colors, especially blue, is defective; the color fields are altered; peripheral visual acuity is reduced in proportion to the severity of the myopia, and space perception often is highly anomalous. Actual distortion exists if there is more than a moderate amount of astigmatism, although the effects of simple myopia alone on the remote peripheral image may produce distortion of considerable degree. Every attempt to paint optical likenesses of persons and objects and particularly landscapes, seascapes or skyscapes demands the use of side vision and the clear understanding of the unique qualities of this vital form of sight. A sound knowledge of perspective and of the differences this produces in size, detail, shading and shadow and of the spatial properties inherent in color, line and proportion must enter into the accurate use and rendition of side vision. The ignorant and the unobserving, the immature and the lazy, the insane and the sensational, the primitivist and the idealist all use the qualities inherent in side vision for the expression of their essential emotions. The correct use of central and side vision, however, requires concentration, intelligent observation, technical mastery and emotional control, and that this combination of abilities is rare is one of the reasons that its perfect flowering has appeared spontaneously so seldom in the whole realm of art.

Peripheral vision often is used by artists who aim merely for effects of mass, line, color or symbolism and particularly by those who are too lazy or too ignorant to draw well. It is the vision used of necessity by all artists suffering from myopia who do not wear correcting lenses,

as well as by those who have a high degree of uncorrected far sightedness and astigmatism. Their work naturally takes on the nature of their visual imperfection, and the whole history of art bears record to the accuracy of this statement. Persons who have refractive errors of any marked degree often are obliged to hold objects within a few inches of the eyes in order to see clearly and in detail. Vision beyond this distance, called the far point, is progressively less distinct and, in general, possesses only the qualities of peripheral vision, with modifications of color and line arising out of the optical defects of the eyes themselves. This was the vision used by Monet, Cézanne and many of their followers. Such vision, in a literal sense, is the vision of objects badly seen, badly remembered and often badly drawn, especially if there is an accompanying visual defect of severity, when the color values also become modified. The picturization of objects seen with peripheral vision is a matter largely of mental interpretation, and this is the doorway through which all sorts of artistic excesses, perversions and daubery have been permitted to gain recognition as true forms of art. An informed public opinion should have recognized this debauchery as evidence of an ocular or mental pathologic state or, as much of it is, deliberate racketeering in art. When such picturization is attempted by real artists having normal vision or by artists having only moderate degrees of myopia, the effects produced, such as those in the best periods of Turner, Carot, Millet, Monet and Renoir, often are most pleasing. Recognition that such work has been and may be a product of myopic or otherwise defective vision must be fittingly made. It has been much more of a factor in the recent past than it will be in the future, owing to the gradual spread of better visual hygiene.

My attention first was drawn to this problem about ten years ago when I became interested in an artist who had a sprightly sense of color and contour but who created curious distortions of details, such as too long hands and enlarged knuckles, which suggested the likelihood of imperfect sight. Examination revealed compound nearsighted astigmatism of —3.00—2.25, axis 63° in the right eye and —3.50—1.75, axis 155° in the left, with which correction he had normal visual acuity. The glass made him aware of the distortions in his painting and led him to complain that the unaccustomed clarity of detail and color made him lose the effects of masses of color and of the essential lines of contour and form which are more marked when vision is blurred. He never became able to paint in his established style when using glasses.

I have a considerable degree of near-sightedness, wearing in the right eye a —4.75 sphere combined with a —2.25 cylinder at the oblique axis of 75° and in the left eye, the master eye, a —4.50 sphere combined with a —2.00 cylinder, axis 105°. The case of the artist just mentioned stimulated my interest in noting the forms of vision which

my compound, near-sighted astigmatism produces when uncorrected. The far point, that is, the point where uncorrected vision ceases to be clear and beyond which it becomes progressively blurred, is only about 15 cm. from the eyes. Within this range I appreciate fine and almost microscopic detail; beyond this, and especially at distances over 20 feet (6 meters), objects become greatly blurred and colors run together with curious blends and unusual, washed-out values. There is definite oblique distortion at far distances, differing in the two eyes, and often only the essential lines of form and contour provide the clues for identification of the object under examination. Such lines frequently take the jazz mathematical shapes of cubism, and if I were a painter my conception often would be essentially geometric. At the symphony concerts my seat is in about the center of the pit, nearly 70 feet (21 meters) from the stage. Three points of attention fix my interest at once: the tall form of the leader in the center, attenuated like an El Greco drawing, two golden harps on the left flank and a strong white reflection from the curved, glistening, light-brown barrel of the bass drum, all striving for attention. The director holds the center of interest, gyrating in strange contortions like some fearful wizard before a medley of misshapen geometric patterns in blacks, grays, whites, brown and gold; there are no details anywhere, merely blurred outlines of color, form, light and movement. The cellos, on the right, appear like enormous yellow-brown gourds placed on the bias; the hands of the cellists form curious patterns, the bowing hand being a yellowish disk weaving in and out, while the hand which weaves over the frets plays up and down at a wholly different angle of inclination. The white shirts of the drummer and of the two men on the extreme flank of the bass viols appear as blots of white and all other shirts as vertical slits. The faces of the players of the stringed instruments form a veritable flower pattern, like great nodding daisies, in whites and yellow-browns; the bowing hands weave up and down as yellowish disks. The black clothes of the conductor and of the row of men next to the audience, that is, the men farthest from the strong overhead illumination, are jet-black, while the identical apparel of the rest of the musicians, directly under the lights, is gray-black, the contrast being sharp. When the harps are seen with one eye and then with the other eye, there is a prompt change in the angle of their inclination from the vertical, which represents the difference in slant given by the different degrees of astigmatism in the two eyes. The same change is noted in the size, shape and slant of the cellos and in the hands and faces. The vision of a single eye is much less distinct and brilliant, as is always the case, than the combined vision, and distortion of objects is much more apparent with one eye than with the two eyes.

If I were a painter and could depict this orchestra exactly as it is seen with uncorrected vision, my place in the forefront of truly impressionistic art would be unchallenged.

Numerous examples of seriously defective vision among artists are matters of record. The myopia of Cézanne and the forced use of his distorted peripheral vision created the pattern for neo-impressionism. His work, except for a few self-portraits, is out of focus and follows no optical laws, and his interpretation of color, form and mass, so far as his pictures exhibit these qualities, is wholly that of distorted side vision, with much of the secondary color defects resulting from the myopia of which he is said to have had a considerable degree. The influence which Cézanne had on the recent baroque movement in art makes necessary some understanding of his personality. As a child he was given to ungovernable attacks of instability and violence, which lasted into adult life. He had almost feminine impressionability, and many of his contemporaries considered him to be merely a "gifted simpleton" and "more than a little mad." The opinions of his contemporary artists and critics are enlightening. Thiebault-Sisson, in *Le Temps* of Oct. 25, 1906, stated: "It is not so much from negligence or wilfulness as it is due to the conformation of his eye which will not permit him to push the most promising sketch to a conclusion."

René-Marc Ferry, in *L'Eclair* of the same date, wrote: "An incomplete talent, whose imperfect vision kept his work undeveloped and always in a state of sketch." The much-quoted Huysmans called him "an artist with diseased retinae, who, exasperated by faulty vision, has discovered the prodromes of a new art." His biographer Vollard stated: "After 115 sittings, Cézanne abandoned my portrait to return to Aix . . . expecting when he returned to Paris to . . . work over certain parts." Cézanne told him: "I hope to have made some progress by that time. You understand, Monsieur Vollard, the contour keeps slipping away from me." Cézanne suffered from diabetes for a long time, a disease well known for its destructive effect on the quality and quantity of vision. He was definitely psychopathic and brought forth his work "in perpetual self-torment and as promptly repudiated it."

Renoir, a virile colorist of the impressionistic group, was much influenced by Monet. Several clues to his ocular condition are given by his biographer Vollard, to whom he spoke of "stepping back a few paces," which gave the painting "the effect of an Impressionistic picture." Such an effect, at the age of 60, could have been produced only by myopia, for in a person of that age the normal result of increasing the distance from a painting to this extent is to improve sharpness of detail. Renoir, in discussing the obsolete form of painting known as petit-point, said: "But the worst of it was, on entering, you were informed that to tell what the pictures represented you must stand two

and a half yards away from them. You know how I love to walk close to a picture and even take it in my hands."[2] Renoir was 64 when he said this and wore no glasses. No person with normal or far sight can appreciate, much less study, detail at close distances without glasses at the age of 64. Only myopic eyes can do this without strain. Such statements are the probable clues to Renoir's often very correct and lovely use of side vision and color and of the ambient beauty of his handling of sunlight. In this connection it should be made clear that myopia of 1 or 2 degrees not only does not seriously handicap a person but focuses the eye perfectly at a comfortable range for painting or reading. Many artists must be wholly unaware that they are myopic, so great is their comfort at ranges for working, and the key to their visual defects often can be determined only by their uniform use of peripheral vision, with its apparitional and rarified graces.

Renoir declared that his artist-friend Lauth was "as near-sighted as a mole." Degas, whose power in depicting the grace and movement of the dance by peripheral vision has not been excelled, was extremely myopic and through his adult life wore heavy lenses.

Pissarro suffered from repeated ulcers of the cornea from the age of 8 years, and these lesions and their scars kept him in constant anxiety and under visual strain. Impairment of central or side vision always is associated with reduction, abnormality or loss of color perception, which is one of the first vital functions to be lost and the last to be regained in ocular disease. It also is well known that lesions of the cortex and subcortex of the brain, particularly of the occipital (visual) lobes, often impair or destroy color perception, without necessarily impairing central visual acuity. Organic disease of the brain can affect the visual function in a number of ways as well as unbalance the mentality, and it probably was a large if not the chief factor in creating the picturized eccentricities of Van Gogh and Gauguin. Modigliani suffered from tuberculosis, wine and women, all of which influenced his consistently prognathous picturization. The astigmatism of John Singer Sargent made him see a red or green line around white objects, which he often painted in as fact.

Gordon Craig, according to Isadora Duncan, was so myopic that he could not distinguish her in detail across their breakfast table. He created his artistic stage effects largely through the medium of his highly defective vision, which gave him essential values of form, color and skeletal construction. Duncan stated that he was accustomed to approach one of the *neue-practische Kunst* apartment houses, exclaim at its gorgeous beauty and then commence "a feverish sketch which, when completed, resembled the Temple of Denderah in Egypt." Certainly, without Craig's myopia the world never would have had Reinhardt, Jacques,

2. Vollard, Ambroise: Renoir: An Intimate Record, translated by Harold L. Van Doren and Randolph T. Weaver, New York, Alfred A. Knopf, 1925, p. 115.

Copeau or Stanislavsky, and it would "still be back among the old realistic scenery, every leaf shimmering on every tree and all the houses with all their doors and windows opening and shutting." Kharsovina, in her book entitled "Theater Street," remarked: "The legitimate and only true aim of the stage designer is the supremacy of color over detractory details," which, obviously, draws attention away from the central point of attention—the actor. George Grosz, the reformed German cubist, who made his great *tour de force* by representing Christ on the cross in a gas-mask and a pair of Wellington boots, goes about with a pair of binoculars, which his myopia forces him to use constantly. Cubism came easily for him.

The extreme distortions of El Greco are not to be considered in this class, although they take the form mainly of errors due to strong farsighted astigmatism, with its consequent elongation, and are more or less reducible by cylindric lenses. The distortions of his subjects are not constant in degree or position, even in the same pictures, and the probable and accepted interpretation is that this was done for its religious values. This opinion is sustained by the normalcy of his few sculptured pieces.

Derain, Matisse, Picasso, Segonzac, Dufy, Braque, Vlaminck and Bonnard all have obtained their major effects by the conscious or unconscious use of side vision and the subordination of central vision. At least part of this group were myopic. Goethe, Wagner, Schubert, Helmholtz, Virchow, Koch and Bismarck were among the famous myopes, and Goethe's theory of color vision was the first which contained truth. This list could be extended greatly, but the aims and limits of this paper prevent.

The amount of change in many lines of artistry which has arisen out of visual defects may never be known. The facts and records indicate, however, that uncorrected imperfect sight, and especially myopia, has played and does play a rôle of considerable importance in the production of baroque art and, to a lesser extent, has affected and always will affect legitimate forms of all the arts, until the correction of visual defects becomes a racial duty.

ROENTGEN TREATMENT FOR DISEASE OF THE EYE

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In this paper I shall give an account of the technic and dosage employed in the department of roentgenology of this clinic. At the same time, I shall enumerate the diseases of the eye which, in the opinion of my associates and me, respond to roentgen therapy. I shall say nothing of the treatment with radium, as the clinic possesses no radium; the few conditions in the treatment of which the use of radium

TABLE 1.—*Number of Patients with Various Forms of Ocular Tuberculosis Who Received Roentgen Treatment from 1929 to 1935*

Condition	No. of Patients
Tuberculosis of lid and conjunctiva	5
Dacryocystitis	23
Episcleritis; sclerosing keratitis*	129
Keratitis profunda	43
Iridocyclitis acuta*	46
Iridocyclitis; uveitis chronica	129
Tuberculosis of choroid and retina	4
Total	379

* A tuberculous etiology was not always clinically evident.

is indispensable (angiomatous growth and carcinoma of the lid recurrent after plastic operation) are treated at the Radium Hospital. The data in tables 1 and 2 are based on the observations on 800 patients and the results of 2,000 treatments in the department of roentgenology during the past seven years.

EQUIPMENT AND TECHNIC

The present equipment, which was placed in commission in 1926, consists of a machine for roentgen therapy the maximal effect of which is a tension of 130 kilovolts and an intensity of 100 milliamperes; it has an oil transformer, and a rectifier supplies direct current. With this equipment foreign bodies are localized (Sweet), and the diagnostic roentgenograms of the skull, paranasal sinuses, sella turcica and orbits are taken. A metalix tube is employed for treatment, and a water-cooling system is used. The amperage is 4 milliamperes, and the strength of the current of the Coolidge tube is 4 amperes. We usually employ a distance of 23 cm., secured by means of a lead glass cylinder.

with a diameter of 5 cm., which comes in contact with the orbit. The voltage varies from 80 to 130 kilovolts, and aluminum filters of from 1 to 3 mm. and copper filters of 0.2 to 0.5 mm. are used. Generally aluminum filters of 2 or 3 mm. are employed. In this paper the international unit of roentgen radiation (roentgen [r]) will be used in preference to the skin erythema dose. One skin erythema dose is equivalent to 550 roentgens. Our single dose varies from 60 to 200 roentgens, and three or four doses are usually given in one series. We give treatments at intervals of from ten to fourteen days, fourteen days, and three weeks, respectively, between the first and second, the second and third and the third and fourth exposures. The total dose should not

TABLE 2.—*Number of Patients with Nontuberculous Disease of the Eye Who Received Roentgen Treatment from 1929 to 1935*

Condition	No. of Patients
Abundant granulation after extirpation of lacrimal sac	4
Periostitis	2
Mikulicz' disease	1
Hordeolosis	6
Blepharitis	296
Dermatitis; eczema	10
Tumor of lid and conjunctiva (postoperative treatment)	6
Epibulbar carcinoma (postoperative treatment)	12
Trachomatous pannus	3
Phlyctenular pannus	20
Rodent ulcer	1
Superficial keratitis	6
Parenchymatous keratitis (interstitial)	14
Keratitis rosacea	11
Neuroparalytic keratitis	2
Herpetic keratitis	4
Keratitis, other forms	5
Iridochoroiditis	10
Thrombosis of the central vein	3
Hemorrhage into the vitreous	2
Absolute glaucoma	2
Sympathetic ophthalmia	2
Various minor diseases	3
Total	425

exceed 600 roentgens. The time of exposure is from three to eight minutes. An interval of from two to three months must occur before a new series is given. Thus one avoids the formation of radiation cataract, an embarrassing complication which should disappear as a result of the modern regulation of the accurate dosage. To the present we have not observed such a condition in patients treated at the clinic, though we have seen instances (all of posterior polar cataracts) resulting from irradiation of the skin, the hypophysis and pharyngeal fibroma. Clapp [1] gave a detailed account of this condition.

The question arises whether the formation of opacities of the lens in cases of chronic uveitis in which radiation is given is due to metabolic disturbances of the crystalline lens or to the action of radiant energy

1. Clapp, Clyde: The Effect of X-Ray and Radium Radiations upon Crystalline Lens, Am. J. Ophth. **15**:1039 (Nov.) 1932.

itself. Observation with the slit lamp sometimes furnishes an answer and sometimes not. We consider these changes to be due to various pathologic changes in the ciliary body brought about by the action of roentgen rays. Naturally, in cases of malignant growth of the orbit in which surgical intervention is impossible, the necessarily large doses produce cataract; however, the object is the cure of the malignant disease, and cataract is an unfortunate, but unavoidable, accident. In the cases reported in the literature, the cataract was due either to massive doses or to insufficient protection. We are inclined to believe that cataract develops in patients with sensitive skin and predisposition to eczema; at any rate, individual hypersensitiveness must be invoked. Fully realizing the possibility of this complication, we still maintain the great therapeutic importance and value of roentgen therapy in ophthalmologic practice. Hence, total rejection of this form of treatment by some surgeons is not justified. The results obtained in tuberculosis in particular are striking; to disregard this fact would be a mistake. It is obvious that accurate technic is a *conditio sine qua non.* This can be easily acquired; a more difficult question is that of establishing indications. I wish to stress an important point: Centralization of this rather special form of roentgen therapy would of course be ideal. Treatment should be given, if possible, by an ophthalmologist; the clinical course of a given lesion during treatment—the improvement of lack of response—can be adequately evaluated only by the ophthalmologist, who himself must learn through practice to appreciate the indications in order to give the full benefit of treatment to his patients. Or, if this is impracticable, therapy should at least be under his close supervision and should be carried out according to his directions as to the dosage, interval, protection, etc.

TABLE 3.—*Number of Treatments Given to 805 Patients from 1929 to 1935* *

1929	No. of Treatments
1929	308
1930	316
1931	260
1932	328
1933	204
1934	291
1935	285
Total	1,992

* The average number of treatments a year was 284.

When the lids or the orbit is to be treated the eyeball must always be protected. The use of a Müller lead glass prosthesis is insufficient since the use of harder and more penetrating rays. The metallic prosthesis used at our clinic is manufactured by Dr. F. Müller (Wies-

baden) and was described and recommended by Professor Wölfflin (Basel).[2] Its use is well supported by the patient. The inner and outer surfaces of the device must be covered by a layer of ointment to give protection against secondary rays arising from these protective shells. The shell devised by Wölfflin consists of three layers, of lead, cadmium and nickel. The formula for the ointment is as follows: yellow wax, 10 Gm.; liquid petrolatum, 10 Gm., and white petrolatum, to make 100 Gm.

As a surface anesthetic a 0.5 per cent solution of p-n-butylamino-benzol-di-methylamino-ethanol hydrochloride is used.

I have considered the subject of roentgen therapy for ocular disease under the heads of tuberculosis, epibulbar tumor and other diseases. Statistics are avoided; I prefer to give my impressions rather than to present a statistical study. Exhaustive reviews of the literature have been given by Hoffmann[3] and Comberg.[4]

TUBERCULOSIS

Duke-Elder[5] wrote: "It . . . appears . . . that tuberculous disease of the eye is probably a good deal commoner than most ophthalmologists imagine." In Hungary tuberculosis is widespread among the population, especially on the great plains; in the Netherlands I observed a similar situation. A great number of cases of tuberculous involvement of the eye are seen, and the impression is gained that roentgen irradiation gives better results than treatment with tuberculin, though one form of therapy does not exclude the other. Without making cutaneous tests, the value of which is disputable (Pirquet and Mantoux), we base our diagnosis on the anamnesis and principally on the clinical appearance of the ocular disease. Syphilis must be excluded by serologic tests. We do not attribute great importance to focal infection, though in disease of the uveal tract infection of the teeth, sinuses and prostate may play a part. The difficulty is that the removal of the focus does not always cure the condition in the eye. Possibly in Hungary one deals with different clinical material. Tuberculosis is a social problem, and disease of the eye is etiologically dependent on it, representing metastatic infection from the bronchial lymph glands. The best and most rational therapy for tuberculosis of the eye is climatic and is carried

2. Wölfflin, E.: Schlussbemerkung zu weiner Arbeit über: Eine neue Schutzprothese zur Verhütung von Röntgenschädigungen des Auges, Klin. Monatsbl. f. Augenh. **89**:214, 1932.

3. Hoffmann: Die Röntgendiagnostik und Therapie in der Augenheilkunde, Leipzig, Georg Thieme, 1932.

4. Comberg: Physikalische Therapie, in Schieck and Brückner.[8]

5. Duke-Elder, S.: Recent Advances in Ophthalmology, Philadelphia, P. Blakiston's Son & Co., 1934.

out at high altitudes; when this is impossible for social reasons roentgen therapy is a fair substitute.

Tuberculosis may be localized in the following structures: (1) the eyelid, as lupus; (2) the conjunctiva, as ulcer and hypertrophy; (3) the lacrimal apparatus, as chronic dacryocystitis; (4) the cornea and sclera, as scleritis, sclerosing keratitis and deep keratitis; (5) the uvea, as chronic recurrent iridocyclitis, keratitis profunda and chronic uveitis, and (6) the retina, as tubercles, periphlebitis, etc.

Groups 1 and 2.—Tuberculous disease of the eyelid and conjunctiva responds well to the use of ultraviolet rays, and in indolent conditions roentgen radiation may be tried. Three exposures to a dose of 140 roentgens are given through a 2 mm. aluminum filter, with protection of the eyeball if possible.

Group 3.—Chronic dacryocystitis of childhood, often with fistula, is always of tuberculous origin. Roentgen irradiation is the method preferred to operation. In cases in which the diagnosis is doubtful treatment should follow extirpation of the sac. The accompanying tuberculous osteitis requires treatment with hard rays. Three exposures to a dose of 160 roentgens are given through a 4 mm. aluminum filter within a month. After two months a second series may follow. Convincing results have been obtained. The eyeball, of course, is protected.

Group 4.—In a great number of cases scleritis is tuberculous, especially when complicated with sclerosing keratitis. The clinical history is of importance. As the etiology of this disease cannot always be elucidated, every case of episcleritis in our series was recorded in table 1 under the head of tuberculosis. We give roentgen treatment in every case of scleritis in which tuberculosis is suspected. While the scleral inflammation subsides quickly, the corneal involvement is much more obstinate. Three exposures to a dose of 120 roentgens are given through a 2 mm. aluminum filter, with intervals of two and three weeks, respectively, between the treatments. In resistant conditions ultraviolet rays may be tried.

Keratitis profunda is regarded as tuberculous when the Wassermann reaction is negative or a history of pleurisy is obtained. The results of roentgen therapy are slight, though some favorable action cannot be denied. Visual acuity is not much improved. Some authors are inclined to employ radium instead.

Group 5.—In cases of chronic recurrent iridocyclitis roentgen therapy gives the best results, especially in the presence of fine keratitis punctata, which the French call *descemétite*. Sometimes two treatments are sufficient to heal the process; if not, the third should be given after three weeks. The dose is 100 roentgens, with a voltage of 100 kilovolts, filtered through 3 mm. of aluminum. Nodules of the iris and

keratitis punctata vanish with irradiation. Sometimes a slight rise in tension of no significance is observed. Not so remarkable is the effect on chronic uveitis, in the treatment of which roentgen irradiation should be followed with diathermy.

GROUP 6.—In the limited number of cases of disseminated choroiditis and tuberculosis of the choroid and retina in which treatment has been

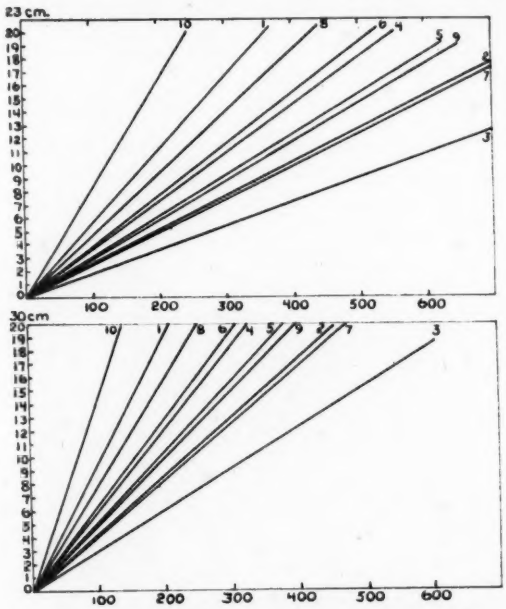

Fig. 1.—Chart showing the time element in the determination of the dosage. The abscissas represent roentgen units; the ordinates, time expressed in minutes. The accompanying table indicates the use of filters and voltage and the number of roentgens per minute.

No.	Filter, Mm.	Current, Milliamperes	Primary Voltage, Kilovolts	Roentgens per Minute	
				30 Cm.	23 Cm.
1	0.5 Al	4	100	10.46	18.0
2	0.5 Al	4	120	23.10	39.4
3	0.5 Al	4	145	32.40	55.0
4	1 Al	4	120	16.20	27.6
5	1 Al	4	140	19.00	32.4
6	2 Al	4	140	15.30	26.0
7	2 Al	4	160	23.50	40.4
8	3 Al	4	150	12.50	21.4
9	3 Al	4	172	20.00	34.0
10	0.5 Cu	4	200	7.05	12.0

given, no encouragement has thus far been offered. However, if no general treatment is helpful, I recommend the following technic: four exposures to a dose of 60 roentgens, with a 4 mm. aluminum filter. Improvement is not to be expected. In cases of periphlebitis of the retina, which is the most important cause of recurrent hemorrhage into the vitreous (Eales' disease) in adults, I must warn against roent-

gen treatment. This condition is highly sensitive to tuberculin, and roentgen therapy or the intemperate use of tuberculin may produce disastrous results. In a case of this disease which I saw, severe hemorrhage was caused by a minimal dose of roentgen rays. In these cases I recommend the use of vitamin C (suggested by Dr. Viallefont).

Summary.—In nearly every case of tuberculosis of the eye the method of choice is roentgen treatment. In tuberculous conditions of the lacrimal sac, periosteum, sclera, cornea and anterior portion of the uvea, the chance of recovery is good.

Disease of the choroid and retina is to be treated with this method only in exceptional cases, as the results are doubtful and harmful effects may be expected. Periphlebitis is a contraindication. Generally, two weeks should elapse between the first and the second treatment, and three weeks, between the second and the third; after two months a new series may begin. In the majority of cases ocular tuberculosis is productive, and the action of the roentgen rays is to lead the process toward fibrosis. The exudative type and proliferating tuberculoma should not be treated with roentgen rays.

MALIGNANT EPIBULBAR AND TARSAL TUMOR

The attitude in our clinic is that every tumor should be treated surgically. Preoperative roentgen irradiation is useful though it is not indispensable; but postoperative treatment should be given invariably. Especially after extirpation of an epibulbar tumor roentgen treatment must follow. The treatment of sarcoma of the choroid and glioma of the retina is exclusively surgical. In cases of bilateral glioma in which the second eye is involved or removed, the use of the diathermic knife (Weve) or radium may be resorted to. We have, however, had no experience in this matter. As our equipment is not suitable for high voltage therapy, orbital growths (lymphoma, chloroma) are not treated at our clinic; the same is true of hypophyseal tumors. In a case at this clinic in which treatment with roentgen rays was given elsewhere, the lymphomatous growths of the lid melted away, and exophthalmos and papillitis subsided gradually. After operation (in cases of epibulbar carcinoma), two exposures are given to a dose of 200 roentgens, through a 3 mm. aluminum filter, with as much protection of the eyeball as possible. In this condition, however, the field of action is much larger for radium than for roentgen therapy (Kumer and Sallmann,[6] Gifford,[7] Schieck and Brückner[8]).

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6. Kumer, L., and Sallmann, L.: Die Radiumbehandlung in der Augenheilkunde, Berlin, Julius Springer, 1929.

7. Gifford, S. R.: A Handbook of Ocular Therapeutics, Philadelphia, Lea & Febiger, 1932.

8. Schieck, Franz, and Brückner, Arthur: Kurzes Handbuch der Ophthalmologie, Berlin, Julius Springer, 1930.

OTHER OCULAR CONDITIONS

In disease of the lid, chronic blepharitis in association with hordeolosis is the most important indication. In cases of the ulcerating and rosaceous type of this recurrent and refractory disease, the best results are given. But in cases of the ordinary squamous marginal type fairly good results are obtained. For chronic seborrheic eczema and dermatitis of the lids roentgen therapy may also be considered. Our technic is as follows: current, 4 milliamperes; distance, 23 cm.; filtration, with 2 mm. of aluminum; dose, 140 roentgens, and voltage, 100 kilovolts.

The loss of cilia must be avoided. The dose must be repeated on the first, eleventh and twenty-fifth days. A protective shell should, of course, be employed.

I must mention also the cases in which abundant granulation tissue appears after removal of the lacrimal sac and the cases of multiple

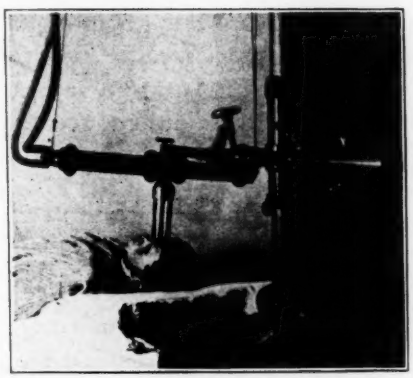

Fig. 2.—Photograph showing a patient during treatment.

papilloma and wart of the lid, in which the treatment consists, respectively, of two exposures to a dose of 160 roentgens with a 2 mm. aluminum filter and three exposures to a dose of 160 roentgens with a 3 mm. aluminum filter.

Keratitis rosacea responds well to roentgen therapy. This disease is a common form of corneal inflammation in adults. The phlyctenular form lends itself least to radiation therapy. In marginal ulcer or in the form which imitates rodent ulcer, clinical amelioration is evident. Recurrence is checked to a great extent. In about nine of eleven cases I observed beneficial effects. The technic consists of three exposures to a dose of 120 roentgens, with a 3 mm. aluminum filter. Clinically, the results are satisfactory. We have observed regression of the pathologic process, even if it was not definitely arrested.

For torpid ulcer, dendritic ulcer and degenerative conditions of the cornea one may try roentgen irradiation, though with meager chance

of success. Two exposures to a dose of 100 roentgens, with a 2 mm. aluminum filter, are made.

Roentgen therapy for interstitial keratitis did not give good results in our hands, though some authors are enthusiastic about the method and claim to be able to prevent the appearance of the disease in the other eye. For the physician who wishes to try the treatment, I suggest the following technic: exposure to from 100 to 120 roentgens, with a 4 mm. aluminum filter, on the first, eighth, fifteenth and thirtieth days. We have never observed any advantage in the use of roentgen rays. One must remember the danger of producing secondary glaucoma. The result is doubtful or nil. The same may be said of scrofulous conditions and the great number of herpetic diseases of the cornea. These conditions are rather indications for treatment with ultraviolet rays or with ionization.

A favorable effect is seen in rheumatic episcleritis (two exposures to a dose of 120 roentgens, with a 2 mm. aluminum filter), though for this condition I always first try ionization, with salicylates or histamine. If the process fails to heal, roentgen rays are always beneficial. For many of the aforementioned conditions, roentgen therapy is doubtless of great value.

In the following group are enumerated the diseases in which results were obtained with roentgen therapy, if one is to believe the reports scattered in the literature.

We had a case of dacryo-adenitis and one of the Mikulicz syndrome; the latter disease responded well to treatment (of tuberculous or leukemic origin?). For acute iritis radiation therapy is unnecessary, as better therapeutic agents are at one's disposal. In cases of cyst of the iris, some authors reported good results from the use of roentgen rays. I suggest two exposures to a dose of 200 roentgens, with filtration through 0.5 mm. of copper, and a similar series after from two to three months. In cases of hemorrhagic and absolute glaucoma in which the patient refuses to permit removal of the eyeball, roentgen irradiation may give relief from pain and may sometimes produce decrease in tension. Three exposures to a dose of 180 roentgens, with a 0.5 mm. copper filter, are given in three weeks.

The optimistic reports of results in cases of thrombosis of the central vein must be corrected. In the first period, in which there is no increase in tension, roentgen irradiation may produce secondary glaucoma. The action on the thrombus is dubious. Concerning the second stage, i. e., the stage of secondary glaucoma, our attitude is the same as that in cases of absolute glaucoma. The use of 540 roentgens divided into three doses may give favorable results as relief from pain but not as a cure for thrombosis. If, nevertheless, this treatment is tried in

exceptional cases, four exposures in ten days to doses of 120 roentgens, with a 4 mm. aluminum filter, is an appropriate technic.

Hemorrhage into the vitreous (of traumatic and arteriosclerotic origin) responds well to diathermy. Nevertheless, a trial of roentgen therapy is not unreasonable. With a 0.5 mm. copper filter, five exposures of 60 roentgens must be given every ten days.

I must still mention exceptional therapeutic experiments, such as those in cases of epiphora, diminution of lacrimal secretion and keratitis sicca, in which through stimulation an increase in the lacrimal secretion is aimed at; others find indication for treatment in cases of iridochoroiditis, panophthalmitis, orbital cellulitis and acute dacryocystitis. A dose of 90 roentgens, with a 0.5 mm. copper filter, is employed. The remarkable success of short wave therapy in surgical and gynecological practice suggests a trial in these conditions also. Unfortunately, sympathetic ophthalmia cannot be prevented or cured by roentgen irradiation, in spite of the fact that a tuberculous etiology has been emphasized lately (Meller).

SUMMARY

Blepharitis, keratitis rosacea and episcleritis are the prinicpal indications commonly observed. In exceptional instances, when all other therapeutic measures fail, roentgen therapy may be attempted in cases of indolent inflammatory conditions of the cornea, thrombosis of the central vein, absolute glaucoma, etc. The results are inconstant and are not convincing. We see no indication for treatment in herpetic, scrofulous processes, trachoma, acute infection of the conjunctiva and cornea, acute iritis, etc. The systematic treatment of the posterior segment of the eyeball (optic nerve and retina) is to be rejected. Stress is laid on the primary importance of roentgen therapy in the treatment of tuberculosis. The secondary importance of treating tumor of the eyeball with roentgen rays as an accessory to the use of radium is also emphasized. The necessary skill should be acquired in establishing proper indications for roentgen therapy on the basis of clinical appearance. But warning must be given against the indiscriminate use of this therapy for every disease of the eye. This treatment is not indifferent, and, if abused, this valuable therapeutic agent is likely to fall into disrepute.

CYST OF THE VITREOUS ATTACHED TO THE RETINA

REPORT OF A CASE

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Cyst of the vitreous is exceedingly rare. Most textbooks of ophthalmology make mention of the fact that such a new growth occasionally occurs and then dismiss the entire subject in two or three lines. In a careful review of the literature I found reports of only ten cases. In addition, three other instances were mentioned in the discussions. This brings the total number of recorded cases to thirteen, all of which will be reviewed in this paper.

The case which I wish to report was that of a boy 17 years old. He came under my observation on Oct. 9, 1935, complaining of occasional haziness of vision and a feeling of "congestion" in the eyes. Examination revealed mild granular conjunctivitis. Vision in the right eye was 20/20 and in the left eye, 20/15. The boy was a high school student, well developed and apparently in the best of health and general physical condition. His parents and two younger sisters were perfectly well. The patient had the usual diseases of childhood but never any trouble with his eyes. Roentgenograms of the skull and the accessory nasal sinuses revealed no abnormality. The urine was normal. A Wassermann test was negative.

The left eye was entirely normal. The media and fundus of the right eye were clear and healthy. The region of the macula was normal. The disk was sharply defined; it showed the usual physiologic excavation and had a good color. The central artery and vein were normal. Directly below the papilla there was a more or less transparent, bluish-white swelling, approximately twice the size of the disk. It was elevated about 5.5 diopters. The surface was slightly pitted. There was no pigmentation of the cyst, and it did not move about in the vitreous with changes in the position of the eye or body. The growth was adherent to the retina and to the central retinal vessels.

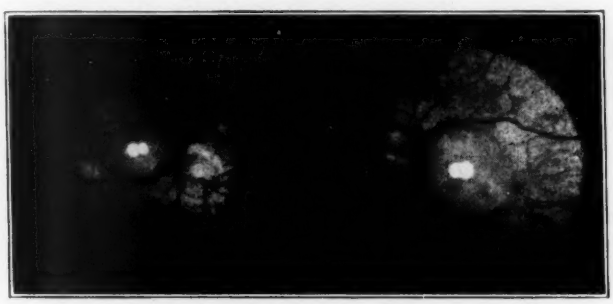
The field of vision of the right eye was slightly contracted temporally. On the tangent screen a large scotoma was made out which was several times the size of the normal blindspot and directly above it. No refractive error was noted after the instillation of homatropine hydrobromate solution.

The accompanying photographs of the fundus of the right eye show the size, position and other details of the cyst and the position of the central retinal vessels.

In my opinion this is a case of congenital cyst of the vitreous adherent to the retina. Dr. Arnold Knapp, who saw this patient in consultation, reported that an unusual picture was presented, as such a cyst is usually smaller and free in the vitreous.

Presented before the Clinical Society of the Harlem Eye and Ear Hospital.

In reviewing the literature I have been unable to find a report of any case of exactly this type. The earliest case of cyst of the vitreous on record is apparently the one reported by J. O. Tansley [1] in 1899 before the American Ophthalmological Society. The patient was also a boy of 17, the son of a physician. He complained of defective vision in the right eye for about one year, during which period the condition remained unchanged. Vision was 20/100 in the right eye and 20/20 plus in the left. Examination revealed an irregularly spherical cyst floating freely in the vitreous. The growth was approximately the size of the disk. The surface showed small indentations "resembling a potato." There were spots and lines of pigment in the capsule, which was transparent, so much so that pigment spots on the posterior surface could be distinctly seen. "The presence of pigment indicates that at some time there had been inflammation." The cyst floated about so freely that



Two views of the fundus of the right eye, showing the position of the cyst.

it jumped rapidly at slight movement of the eyeball, leading Tansley to conclude that the vitreous was fluid.

The second case was reported by Carl Koller [2] in 1901 before the American Ophthalmological Society. The patient was a man 32 years old. Vision in the right eye was 6/6.

> The nasal and lower two-thirds of the disk appear to be hidden by a dazzling white body of egg shape, whose axis is almost vertical. It has a sea green tint, faint bluish steel gray. It has three processes, two short and one long, presenting the well known appearance of a hyaloid artery and ends blind near the nasal lower quadrant of the lens. The field of vision is defective, only the lower nasal quadrant, including the center, being preserved. The cyst is evidently a widening of the hyaloid artery and its connective tissue sheath at its posterior extremity, where it emerges from the optic nerve.

The patient said that he believed his trouble was due to trauma in childhood.

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1. Tansley, J. O.: Tr. Am. Ophth. Soc. **9**:507, 1899.
2. Koller, Carl: Tr. Am. Ophth. Soc. **9**:380, 1901.

Two years later Uribe Troncoso [3] published a report of the case of a girl 15 years old.

The cyst, oval in shape, appeared to be in the anterior part of the vitreous; it was semitransparent in its upper portion, where it was sprinkled with brownish-black dots, and completely black in its lower part. It was freely movable, and had a consistency similar to that of the vitreous. It gradually settled to the bottom of the eye when the eye was at rest. Because of the pigment spots on the cyst wall it was thought to be derived from the uvea.

The fourth case was described by Derby [4] before the American Ophthalmological Society in 1909. The cyst was in the left eye of a man 40 years old.

On the temporal side of the disk and overhanging it, is a rounded prominence of pear-shaped outline, with the neck of the pear overhanging the disk. Running over the tumor are a few, small, tortuous retinal vessels. The tumor is translucent and gives a greenish reflex on its outer border. Size slightly smaller than the disk.

In 1913 Shine [5] presented a case before the Section on Ophthalmology of the New York Academy of Medicine. The patient, a woman aged 29, complained of headaches. Examination disclosed a cyst of the vitreous, twice the size of the optic disk, which floated freely when the eyeball was moved but always settled down behind the ciliary body. This suggested that there was an invisible filament still attached to the ciliary body. The cyst was round, steel gray and semitransparent. Shine considered it a congenital cyst composed of epithelial tissue, an outgrowth from the ciliary body.

At this meeting Fridenberg reported another case of floating cyst of the vitreous. The cyst moved slowly, but no strand of attachment could be seen. The growth was slightly pigmented.

In 1919 at a meeting of the Section on Ophthalmology of the American Medical Association, de Schweinitz and Wiener [6] reported a case of congenital multilocular cysts in relation to the retina. The patient was a man 22 years old. Vision in the left eye had been reduced to perception of light since childhood. In the macular region there was a large transparent cyst, with small vessels on the surface. From the lower temporal edge of the cyst, for a distance of 3 disk diopters there was a narrow transparent tube carrying two atrophic vessels. This tube resembled a manifest canal of Cloquet. It terminated in a wide-spreading cystlike mass, less transparent than the one in the

3. Troncoso, Uribe: Ann. d'ocul. **130**:341, 1903.

4. Derby, Richard H.: Tr. Am. Ophth. Soc. **12**:827, 1909-1911.

5. Shine, Francis W.: Arch. Ophth. **42**:308, 1913.

6. de Schweinitz, G. E., and Wiener, M.: 1. Cysticercus of the Viterous; 2 Congenital Multilocular Cysts in Relation with the Retina; 3. Anterior Lenticonus. J. A. M. A. **73**:1187 (Oct. 18) 1919.

macula and fully four times as large. The surface of the mass was covered with vessels. The lower and middle fields of the fundus were occupied by deposits of retinal pigment.

Since 1928 the reports on intra-ocular cyst have been more numerous. In 1929 Hunter W. Scarlett [7] described a case at a meeting of the American Ophthalmological Society.

The patient, an Italian girl, aged 8 years, complained of intermittent blurred vision in her left eye for six months previous to her admission to the dispensary. On one occasion the vision in the affected eye was 6/30, while at a later examination vision equaled 6/6. When the eye was stationary, the ophthalmoscope showed a translucent cyst one and one-half times the size of the disk, somewhat oval in shape, situated toward the anterior temporal quadrant of the vitreous. The lower part of the cyst was broader than the upper, and near the junction of the middle and lower thirds there was a constriction which, in certain positions, gave it the appearance of possessing a small cap. Sprinkled over the surface of the cyst were numerous black pin-point dots. The upper end showed a small head-like protuberance. When the eye moved quickly in different directions the cyst assumed various positions, but as soon as the eye resumed a normal position again the cyst righted itself into the primary posture. No attachment to any part of the interior of the eye could be detected, and it was inferred, from the manner in which the cyst moved, that the vitreous was fluid in character. The disk was well defined and of good color, and the rest of the fundus was healthy; no trace of hyaloid remains was seen. The right eye was normal, and vision equaled 6/6.

In the discussion of Scarlett's case, another case was described by Emory Hill, of Richmond, Va.

I desire to place on record a similar case which has been under my care for eighteen months and had previously been treated by Dr. W. E. Bruner, of Cleveland, for two and a half years. A man in middle life came complaining of poor vision, which has varied from 5/60 to 5/30 plus in the right eye, and from 5/40 to 5/20 in the left eye. The nerve-heads were described by Dr. Bruner as slightly pale, especially in the lower temporal quadrants, in 1925. They were decidedly atrophic in 1928. There are fine vitreous floaters in each eye and slightly contracted retinal arteries. In the right eye there is a cyst floating in the vitreous without any apparent attachment, moving only slowly with the movements of the eye. It reaches to the anterior portion of the vitreous, is perfectly globular, and appears about two-thirds of a disk-diameter in size. My observation and that of Dr. Bruner would indicate that there has been no change in the three and a half years since the patient was first seen. The visual fields are slightly contracted in all meridians, the blind spots are much enlarged, reaching almost to fixation, and there are relative central scotomas for white and colors.

The next case was reported by Chester E. Hurwitz [8] in 1933 before the Section of Ophthalmology of the Baltimore City Medical Society. The patient was a girl of 13 who had a small amount of myopic astigmatism.

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7. Scarlet, Hunter W.: Tr. Am. Ophth. Soc. **27**:154, 1929.

8. Hurwitz, Chester E.: Cyst in the Viterous, Arch. Ophth. **9**:825 (May) 1933.

Examination with the ophthalmoscope revealed the presence of a cyst floating freely in the vitreous. The cyst was round, about the size of the optic disk. The vitreous must have been quite fluid, for no matter in what position the patient held her head the cyst always sank to the lowermost level of the eye. When the patient lay face down, the cyst was seen almost against the lens; when she lay looking up, it was far back in the vitreous. The cyst was not connected or attached to any structure in the eye. On motion of the eye it moved from place to place, but rather quickly returned to the lowermost part. The specific gravity was therefore somewhat greater than that of the vitreous. It rotated freely in all directions but always settled with the same side down, that side evidently being the heaviest. The cyst contained on its surface many irregular spots of pigment, most numerous on the under surface. The capsule, if there was any, was very thin. The contents of the cyst were transparent, the posterior wall being visible through the cyst, and the posterior pigment spots differentiated from the anterior by a parallax motion. The retinal blood vessels could also be clearly seen through the body of the cyst.

Another case was reported by Edward Stieren,[9] of Pittsburgh, in 1933.

The patient was a colored girl, 6 years old, who was brought to the Columbus Hospital Eye Clinic because of defective vision. About two disk-diameters above the macula, there was a bluish white cyst, about one half disk-diameter in circumference, which seemed to arise in opaque nerve fibers. It appeared to have an elevation of five diopters, and "resembled closely a miniature frosted electric light bulb." A pulsating vein surmounted the cyst. The Wassermann was negative.

Stieren was convinced that this was a congenital cyst.

Robert Scott Lamb, of Washington, D. C., in discussing Stieren's case, reported as follows:

Perhaps these cases are not quite so infrequent as they may seem. I recall a man coming into my office some years ago with a history that while shaving that morning he found that he was blind in one eye. He believed that the loss of vision had occurred suddenly. On examination I found a bluish-gray cyst that evidently had been present for years. He was forty-nine years of age and had never discovered that his central vision in one eye was gone.

In 1934 Charles B. Meding[10] described a free cyst in the vitreous in a woman 42 years old. She entered the Harlem Eye and Ear Hospital because a "black ball passed her right eye and interfered with her work." Vision was 20/20, and the fundus was normal.

On sudden movement of the right eyeball a round lens-shaped body immediately posterior to the lens floated across the enlarged pupil and sank slowly out of sight. Except for smudges of dark brown around its edge the body was translucent and behaved very much like a dislocated lens. . . . Examined by the retinoscope the brown smudges proved to be granular deposits of pigment on the surface, the translucent content permitting a veiled vision of the fundus to the

9. Stieren, Edward: Tr. Am. Ophth. Soc. **31**:116, 1933.

10. Meding, Charles B.: Free Cyst Floating in the Vitreous, Arch. Ophth. **11**: 973 (June) 1934.

observer and a like vision of near objects to the patient. . . . No connecting band or filament could be demonstrated.

Dr. Meding stated that this cyst was probably congenital.

From the foregoing review of the various cases reported and mentioned in the literature, a few data concerning this little known condition of cyst of the vitreous can be summarized as follows: Apparently few of the patients had any complaints traceable directly to the presence of the growth. The ages ranged from early childhood to past middle life. The two sexes seemed to be affected about equally. The presence of a cyst does not necessarily impair the acuity of vision, though usually there is some defect in the field. The structure may be formed either before the retinal circulation has been established, in which case the retinal vessels are seen over the cyst, or later. Some spring from the hyaloid artery; others develop between the layers of the retina, and still others originate in the uvea, as evidenced by the presence of pigment. All cysts are more or less globular, varying in size from one-half disk-diameter to as much as five times the size of the papilla. The color is usually gray, blue, white or greenish. A cyst which is green suggests a hemorrhagic origin. As a rule the cyst is either transparent or semitransparent. Free movement is found in approximately one of three cases. The favorite sites of the fixed cysts are the disk and the macula.

RELATIONSHIP OF SINUSITIS TO OPTIC AND RETROBULBAR NEURITIS

WITH SPECIAL REFERENCE TO ETIOLOGY AND TREATMENT

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The literature on the relationship of optic and retrobulbar neuritis to sinusitis abounds with good material considered both from the anatomic and from the clinical point of view. Much of this is of such an extremely controversial nature that considerable confusion arises in the minds of the reader as to the real status of the sinuses in disturbances of the optic nerve. The continued recording of cases in which startling recovery occurred after operation on the sinuses does not tend to dispel this confusing situation. A real scientific investigation of this subject would seem desirable to place it in some degree on a standardized basis. In the absence of such an investigation much can be learned from an analysis of the anatomic and the clinical work on this subject that has been recorded within the last thirty years. In this discussion no historical review of this subject will be attempted, as this has been well done in recent articles. Only material will be referred to that may have a practical bearing on the question of the etiology and treatment of optic and retrobulbar neuritis, especially from the standpoint of the otolaryngologist.

ETIOLOGY

Most of the earlier investigators of this subject, writing both from the anatomic and from the clinical point of view, expressed the opinion that in the great majority of cases optic and retrobulbar neuritis were secondary to infections of the sinuses. Many cases were reported emphasizing this connection and the benefits resulting from operation on the posterior ethmoid and sphenoid sinuses. However, there were some, even after the convincing anatomic studies of Onodi,[1] Loeb[2] and

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Read before the joint meeting of the Section on Ophthalmology and the Section on Otolaryngology of the College of Physicians of Philadelphia, Jan. 16, 1936.

1. Onodi: The Optic Nerve and the Accessory Cavities of the Nose, Ann. Otol., Rhin. & Laryng. **17**:1 (March) 1908.

2. Loeb, H.: A Study of the Anatomic Relations of the Optic Nerve to the Accessory Cavities of the Nose, Ann. Otol., Rhin. & Laryng. **18**:243 (June) 1909.

Schaeffer,[3] who did not agree that optic neuritis was caused by sinusitis. A comprehensive review of these earlier differences of opinion has been given by Crane [4] in a paper published in 1927. These early writers gave little consideration to any etiologic factor other than sinusitis. During the last few years still more writers have broken away from the earlier prevailing opinion and have emphasized the importance of other conditions as etiologic factors.

At the present time there are a number of causative agents to be considered, and I shall enumerate them as follows in what I consider to be the order of their importance: (1) multiple sclerosis; (2) toxic conditions, such as from diseases of the kidneys, burns, the use of methyl or ethyl alcohol and the excessive use of quinine, salicylates, iodoform, lead, arsenic and tobacco; (3) tumors or cysts of the basal portion of the frontal lobe; (4) acute infectious diseases, such as erysipelas, mumps, influenza, tonsillitis, measles, pneumonia and malaria; (5) foci of infection, such as the teeth, tonsils, sinuses, appendix, gallbladder, prostate, fallopian tubes and genito-urinary and intestinal tracts; (6) syphilis; (7) metabolic disturbances, such as diabetes, pernicious anemia and myelogenous leukemia; (8) lactation; (9) tuberculosis, and (10) Leber's disease.

Of these causative factors, the ones that concern otolaryngologists are, of course, those having reference to the sinuses and tonsils. It is still the opinion of many prominent clinicians, both ophthalmologists and otolaryngologists, that disturbances of the optic nerve are due chiefly to infection of the adjacent sinuses. Their belief is based mostly on the fact that operation on the posterior sinuses in the presence of optic and retrobulbar neuritis greatly benefits the condition in spite of the fact that usually no pathologic process is found in these sinuses. It has been stated that the type of sinusitis most often associated with lesions of the optic nerve is the hyperplastic type, though the lesions may occur in cases of purulent sinusitis. There have been comparatively few cases reported in which a frankly purulent condition of the sinuses has been found at operation. On the other hand, it has been repeatedly observed that no gross pathologic process whatever has been found, and even histologic examination of mucosa that has been removed from the sinuses has failed in many cases to reveal a pathologic process, although the ocular symptoms have been relieved or cured after the operation.

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3. Schaeffer, J. P.: The Nose and Olfactory Organ, Philadelphia, P. Blakiston's Son & Co., 1921.

4. Crane, C. G.: The Anatomic, Pathologic and Clinical Relationship of the Posterior Sinuses to Optic Neuritis, Ann. Otol., Rhin. & Laryng. **36**:201, 1927.

In addition to this apparent clinical basis of an association of these conditions, there appears also to be an anatomic one, because of the close relationship of the posterior sinuses and the optic nerve. When Onodi [1] in 1908 described this anatomic relationship between the optic canal and the posterior sinuses, he felt that there was definitely established an etiologic relationship between disturbances of vision and disease of the posterior sinuses. One year later Loeb [2] published the results of studies of a similar nature which tended to show this same anatomic and apparent etiologic relationship. In 1920 Schaeffer's [3] work further emphasized this same connection.

It appears from these anatomic studies that the extent of development of the posterior ethmoid cells and the sphenoid sinus influences to some extent the size and shape of the optic canal. A sphenoid sinus enlarged superiorly or externally may come in such close contact with the optic canal that an indentation of the canal occurs, causing a diminution in the size of the optic canal. Closer contact may result in a dehiscence of bone covering the optic nerve, so that its sheath lies in close contact with the mucous membrane of the sinus. It is not uncommon for the posterior ethmoid cells at the posterior external angle of the ethmoid capsule to encroach on the optic canal, tending to lessen the diameter of the canal and change its shape to oval or angular rather than round. When an optic canal is thus made abnormally small by crowding of the sinus cells, there is present a condition that may result in serious injury to the contained nerve should there be any immediate or remote pathologic process to cause edema with consequent pressure within this canal. Such close contact of the sinus and the optic canal as to cause a dehiscence between the two would appear to be less favorable for injury of the optic nerve because any pressure in the canal would not be confined by rigid bony walls.

When these early anatomic studies had so firmly established the close association of the posterior sinuses and the optic nerve, the first thought regarding the etiologic relationship was that there was a direct extension of infection from the sinuses to the nerve. This thought has been advanced and emphasized by many and is still a favorite theory, although it has been disputed by careful students of this subject. In 1927 Crane [4] expressed the belief not only that there was a likelihood of direct extension of infection but that a simple inflammation of the sinuses was sufficient to cause hyperemia of the nerve and pressure without actual extension of the infection. He felt that when the nerve tissue itself was involved by extending infection the results were likely to be serious. His studies further led him to believe that the close association of the arterial, venous and lymphatic circulations of the orbital structures and

posterior sinuses invited a toxic invasion of the nerve, setting up an irritation or inflammatory swelling with resultant pressure. Coffin [5] expressed the belief that the changes in the optic nerve were edema produced by thrombophlebitis of the ethmoid and ophthalmic veins secondary to infection in the sinuses.

It appears, then, that many hold the view that direct pressure by an extending infection is the main factor in the production of retrobulbar neuritis; others believe that edema of the optic canal with resulting venous stasis is more common; others are of the opinion that there is a transmission of toxins into the canal around the vein of Vossius and the capillaries supplying the central bundle; still others believe that there is transmission of actual infecting organisms by the blood stream from some distant focus to the nerve itself. White,[6] who gave this subject probably more thought and study than any one else, expressed the belief in 1928, shortly before his death, that invasion of the optic nerve was always hematogenous from some focus of infection and he stated definitely that he had never observed a case, except instances of malignant disease of the sphenoid sinus, in which he thought that there was direct extension from the sinuses to the optic nerve. To account for the invasion of the nerve by circulating bacteria or toxins, White [6] advanced the theory of negative pressure within the posterior sinuses. He stated that the drainage and ventilation of those sinuses are at times impaired to the degree that negative pressure results from the absorption of the oxygen or air contained within the sinus. Such a condition would favor the emigration of bacteria and toxins from the blood stream to the optic nerve because of its close association. He further suggested that the benefits following operation on the posterior sinuses result from a relief of the negative pressure and not from the removal of any focus of infection.

Stark [7] has advanced a theory of anaphylaxis to account for involvement of the nerve from a focus of infection. He expressed the belief that there may be a sensitization of the tissues of both the sinus and the orbit by bacterial proteins, producing an allergy resulting in a localized anaphylactic reaction each time the person comes in contact with a fresh infection of the same bacteria in the nose, teeth or tonsils or some other part of the body. In my opinion, the allergic state as a pos-

5. Coffin, L. A.: A Further Discussion of Affections of the Optic Nerve Due to Sinus Disease, Ann. Otol., Rhin. & Laryng. **37**:165 (March) 1928.

6. White, L. E.: The Location of the Focus in Optic Nerve Disturbance from Infection, Ann. Otol., Rhin. & Laryng. **37**:128 (March) 1928.

7. Stark, H. H.: Retrobulbar Neuritis Secondary to Diseases of the Nasal Sinuses, J. A. M. A. **77**:678 (Aug. 27) 1921.

sible etiologic basis in some of these cases should not be dismissed without further thought and investigation.

Within recent years the belief has been gradually strengthened that infection in the sinuses plays a minor rôle in the causation of disorders of the optic nerve, and when it is the cause it is in all probability a factor only as a focus of infection and not by extending infection. As the maxillary sinus in adults is more commonly infected than any of the other sinuses, it seems likely that this sinus is more often a causative factor than the sphenoid or posterior ethmoid cells.

In 1928 Leon White,[6] who for years before had been a strong advocate of the etiologic relationship of sinusitis and optic neuritis, changed his opinion and emphasized his belief that in the great majority of cases optic neuritis is due to a focus elsewhere in the body, particularly in the teeth or tonsils. This idea met with an immediately favorable response from others, and since then the teeth and tonsils have received as much consideration as causative agents as the sinuses. It seems that the enthusiasm of some of these observers for a particular line of thought has led them to overlook more frequent and more important causes of disorders of the optic nerve, such as multiple sclerosis. In 1934 Lillie[8] stressed the unimportance of infection of the sinuses as a cause of disturbances of the optic nerve. His report of 225 cases of retrobulbar and optic neuritis observed at the Mayo Clinic included only 1 case in which the condition was actually due to sinusitis. By far the most common cause of the ocular trouble was multiple sclerosis. Benedict[9] also minimized infection of the sinuses as an etiologic factor and stressed the importance of multiple sclerosis.

Most of the recent writers on this subject have agreed that multiple sclerosis is the most frequent cause of disorders of the optic nerve. Some of them have stated in their reports of series of cases the percentages of the various causes, but others are reluctant to give percentages, realizing that in many cases assigned to a particular cause the condition may later develop into definite multiple sclerosis. Of recent years the percentage of cases in which the disorder of the optic nerve is attributable to sinusitis has been definitely lowered, but it still varies considerably. Wilmer[10] estimated the number of his cases in which the condition was rhinogenous as 11 per cent; Langerbeck, as quoted

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8. Lillie, W. I.: The Clinical Significance of Retrobulbar and Optic Neuritis, Am. J. Ophth. **17**:110, 1934.

9. Benedict, W. L.: Retrobulbar Neuritis and Diseases of Nasal Accessory Sinuses, Arch. Ophth. **9**:893 (June) 1933.

10. Wilmer, W. H.: Chronic Retrobulbar Neuritis, Arch. Ophth. **4**:817 (Dec.) 1930.

by Hoople,[11] as 3.5 per cent; Walker,[12] as 4 per cent, and Scheerer,[13] in a series of 203 cases, as 1.5 per cent.

In 1931 Woods[14] and Rowland, of Johns Hopkins University, reported an etiologic study of a series of 138 cases of optic neuropathies, including primary atrophy of the optic nerve, secondary atrophy of the optic nerve, retrobulbar neuritis, atrophy of the papillomacular bundle, optic neuritis and choked disk. In only 6.5 per cent of these cases was the condition attributed to multiple sclerosis, and in 8.1 per cent, to disease of the posterior sinus. The opinion of many other writers as to the etiology of disturbances of the optic nerve might be cited; but opinions and percentages of the various causes given a few years ago are of no value today for the reason that further observations and investigation have caused many of these writers to alter both their opinions and the causal percentages.

In reviewing many of the reported cases of retrobulbar and optic neuritis, I have observed the scarcity, almost the absence, of this condition in childhood. This may have some significance as far as the relationship between disturbances of the optic nerve and sinusitis is concerned, when one considers the greater frequency of infection of the sinuses in infants and young children as compared with the incidence in older children and adults. It may be argued that the sinuses of infants and children, especially the sphenoid sinuses, are insufficiently developed to come in close association with the optic nerve. This, perhaps, would be a sufficient answer to the question of the scarcity of cases in children if disturbances of the optic nerve were considered due to direct extension from the sinuses. There appears, however, to be fairly general agreement that if the sinuses are a cause of disturbance of the optic nerve they are so usually as a focus of infection and only rarely by direct extension. The great frequency of sinusitis in young children with practical absence of retrobulbar or optic neuritis would appear, then, to be an argument against sinusitis as a cause of disturbances of the optic nerve. However, there is another factor to be considered that may tend to lessen or prevent optic neuritis in children and that is an anatomic peculiarity of the optic canal. White[15] demon-

11. Hoople, J. R.: Retrobulbar Neuritis: Rhinological Findings, New York State J. Med. **33**:365, 1933.

12. Walker, C. B.: Retrobulbar Neuritis and Multiple Sclerosis, California & West. Med. **34**:5 and 83, 1931.

13. Scheerer, H.: Retrobulbar Neuritis, Klin. Monatsbl. f. Augenh. **83**:164 1929.

14. Woods, A. C., and Rowland, W. M.: An Etiologic Study of a Series of Optic Neuropathies, J. A. M. A. **87**:375 (Aug. 8) 1931.

15. White, Leon: An Anatomic and X-Ray Study of the Optic Canal in Cases of Optic Nerve Involvement, Ann. Otol., Rhin. & Laryng. **33**:121 (March) 1924.

strated that the optic canal of infants and children is of practically the same diameter as that of an adult. A child's optic nerve proportionate in size to the size of the child, therefore, would not fill the optic canal and might allow considerable swelling of the nerve by edema or infiltration before being subjected to pressure sufficient to cause ocular symptoms. This may account for the infrequency of such cases in young children in spite of the great prevalence of sinusitis.

This brief review of the etiologic factors in optic and retrobulbar neuritis is far from complete. No attempt has been made to evaluate each separate factor. Only a few points bearing on the situation of the sinuses in this etiologic program has been discussed. It is regrettable that there is not more agreement on the status of the sinuses as causative agents among those having the greatest experience in these cases. This condition appears still to be in the stage where individual opinions and theories prevail, and a great deal of real clinical and probably experimental research will be necessary to place the status of the sinuses in disturbances of the optic nerve on a foundation acceptable to all.

TREATMENT

A principle of treatment of any pathologic condition should be the elimination of the cause if possible. When this principle is applied to the treatment of a condition in which not only the etiology but individual ideas concerning etiologic factors are variable, the treatment is far from being on a standardized basis and will vary widely according to one's conception of these causes. The treatment for optic and retrobulbar neuritis, therefore, will be found to be somewhat different in the hands of various clinicians.

In earlier years, when the condition was almost universally considered closely associated with infections of the sinus, the main treatment naturally was largely in the hands of otolaryngologists. During this period the operative procedure was chiefly the opening of the ethmoid and sphenoid sinuses, the conservative type of operation being usually preferred to the radical. The good results, often unexplainable on the basis of any demonstrable pathologic process in the sinuses, caused an enthusiasm for this type of treatment that apparently delayed for a considerable time investigation and discovery of other etiologic factors. White [15] attempted to explain the frequently spectacular improvement of the ocular symptoms following operation on the sinuses by a release of negative pressure in the posterior sinuses, but this has not been generally accepted.

Benedict [9] in 1933 advanced a more practical theory for improvement in these cases after operation. He believed that it was due to an improvement in the circulation of the nerve. He reasoned that packing of the

nose with gauze soaked in cocaine hydrochloride and epinephrine hydrochloride for anesthesia produced first ischemia and then congestion of the membranes. After the operation there would be continued congestion of the mucosa of the sinus and adjacent tissues until healing was complete. In addition, the usual rise of temperature immediately after the operation, which he attributed to absorption of blood, had an effect similar to that produced by the injection of foreign proteins. He stated that the same intranasal effect could be produced by the application of a 2 per cent solution of iodine to the nasal mucosa and that improvement of the peripheral circulation, including the optic nerve, could be produced by the administration of nitrites or pilocarpine, drugs that produce sweating and other vasodilating agents.

The same startling improvement of the ocular symptoms has been observed from other surgical procedures, such as removal of the tonsils and extraction of teeth. It has been noted, however, that after such operations and after surgical treatment of the sinuses the improvement may be only temporary, relapse commonly occurring.

An impetus for the search for and removal of foci of infection in the treatment of these disorders was given by White's emphasis of the important rôle that such organs as the teeth and tonsils play as causative factors. In 1928 he recommended that the suspicious teeth should first be eliminated as a possible factor and then the tonsils investigated as the next most probable cause. His line of procedure was to remove the tonsils if definitely diseased and, while the patient was still under the anesthesia, have the dentist remove any suspicious teeth. Of the sinuses, he stated that the maxillary is the most common seat of infection; he advised that a window opening be made beneath the lower turbinated bone if the mucous membrane was thickened and that a more radical operation be performed if a marked pathologic process was found. At that time he expressed the opinion that infection of the sinuses is a rare cause of disturbances of the optic nerve. If involvement of the posterior sinuses is suspected, he stated that conservative intranasal treatment, such as the use of a spray of ephedrine hydrochloride, irrigations with hot saline solution, suction, the application of tampons moistened with mild protein silver, etc., or the removal of the middle turbinated bone would probably be sufficient. If definite infection of the sphenoid or ethmoid sinuses is found, he advised exenteration of the ethmoid sinus and removal of the anterior wall of the sphenoid sinus. He also advocated this procedure as a therapeutic measure in those cases in which atrophy of the optic nerve was to be feared, in which roentgenograms showed the optic canals to be abnormally small and also in cases in which there was complete loss of vision. He believed that there would be spontaneous recovery in 50 per cent of all cases.

In these cases of optic or retrobulbar neuritis there are certain procedures that are obviously important. In some cases a causative factor may be quickly discovered and appropriate or specific treatment quickly instituted. Cases of involvement of the optic nerve due to tumor, syphilis, tuberculosis and extraneous toxins, such as alcohol, nicotine or lead, may be thus quickly disposed of. The great majority of patients, however, require extremely exacting study, and this should be done as quickly as possible by the close cooperation of the ophthalmologist, otolaryngologist, neurologist, dentist and internist. As soon as the ophthalmologist has made the diagnosis of a disorder of the optic nerve, it would seem important for the neurologist to study the patient from the angle of a possible tumor of the brain or multiple sclerosis. A spinal puncture would be of considerable help. As in at least half the cases retrobulbar neuritis is due to multiple sclerosis, the neurologist may be able to make a diagnosis quickly. The part of the otolaryngologist should be the thorough examination of intranasal tissues for evidence of infection of the sinuses as well as investigation of the tonsils and ears. In the intranasal examination emphasis should be placed on the careful inspection of the mucosa in the middle meatus, in the spheno-ethmoid recess and around the ostia of the sinuses by means of the nasopharyngoscope. In my opinion, too much importance must not be given to a somewhat hyperemic and hyperplastic mucous membrane in these localities, for they may indicate only a recent acute rhinitis or sinusitis that is subsiding satisfactorily and having no effect on the optic nerve. Roentgenograms of the sinuses also seem important, but here again a diagnosis of thickened mucous membrane lining the sinuses may mean only a subsiding acute infection. A roentgenogram of the optic foramen has been advocated to detect its size, and this may be of some prognostic value. The dental report is of great value, especially if supplemented by roentgenograms of the teeth. The internist has his part in the examination of other parts of the body for a focus of infection, a disease of the blood, evidence of extraneous poisons, etc. A Wassermann test should always be made.

While these examinations are in progress and pending the discovery of an etiologic factor, it is important for the patient to have been under a conservative type of treatment from the first, such as control of the diet and attention to hygiene, the promotion of sweating either by drugs or by physical means and perhaps the injection of a foreign protein, which has given beneficial results in cases in which the condition is due to multiple sclerosis. In addition, it would seem wise to institute local treatment of the nose by the use of astringents, such as ephedrine or epinephrine, either as a spray or as a pack, irrigation with hot saline solution, application of tampons treated with mild protein silver or suction.

When the examinations are completed, if a diagnosis of multiple sclerosis has been made fairly satisfactory treatment can be carried out; if infected tonsils have been found they can be removed; suspicious teeth can be extracted; other foci of infection can be treated or eliminated; if there is a possibility of sinus infection it would seem wise to continue only the conservative treatment. If a purulent condition is found in one or more sinuses, I would advise operation on the involved sinuses. If this infection is in the acute or subacute stage, it would seem sufficient in case the maxillary sinus is involved to make a window opening under the lower turbinate bone; if the sphenoid sinus is involved the procedure would be to remove the anterior wall, and if the frontal or the ethmoid sinus is involved, to perform a middle turbinectomy and ethmoidectomy, care being taken to exenterate those cells in the posterosuperior angle of the ethmoid capsule. It a chronic infection of the sinuses or polyps are present, more radical operations on the involved sinuses would appear to be indicated. After operation the nose should be kept free from crusts, and an attempt should be made to prevent the formation of or to reduce excess granulation tissues.

It has been shown that after all examinations have been completed there are from 15 to 20 per cent of these cases of involvement of the optic nerve in which no apparent cause can be discovered. In the opinion of some writers there will be evidence of multiple sclerosis in many of these cases. In cases in which no cause can be discovered the treatment can be directed according to the conservative principles as previously mentioned for a week or more, depending on the progress of the condition in the optic nerve as shown by examination of the fundus. If complete blindness occurs or there are signs of atrophy of the optic nerve it seems essential that anything that would give any hope of controlling the condition should be tried. It is in these cases that operation on the apparently normal sinus may justifiably be performed, and from the experience of many writers some hope of controlling the disease of the nerve by this means may be entertained.

SUMMARY

A brief review of some of the theories and opinions regarding the status of the sinuses in cases of optic and retrobulbar neuritis has been attempted. Various causes of this condition are enumerated in what I consider the order of their importance. An opinion is expressed regarding the scarcity of cases in infants and young children. An outline of a practical method of handling this condition has been suggested, with emphasis on the part to be played by the otolaryngologist, which is of conservative rather than of radical nature.

DISCUSSION

DR. W. I. LILLIE: My experience in relation to sinusitis as a causative factor in acute retrobulbar neuritis is still on the negative side.

A number of years ago when the late Dr. Leon White of Boston very strongly favored sinusitis with or without clinical or roentgenographic manifestations as a frequent cause of retrobulbar neuritis, my interest was stimulated by a large series of cases of sinusitis, the posterior ethmoid and sphenoid sinuses being involved. The ophthalmologic examination included the central vision, the fundi and the perimetric fields. Nothing even suggestive of retrobulbar neuritis was elicited. I was informed a few years ago by a member of the Boston group that a number of the patients on whom the late Dr. White had reported returned with positive evidence of multiple sclerosis.

That acute retrobulbar neuritis may be the first, second or third prodromal episode of multiple sclerosis is well established. Also, spontaneous recovery of vision in a varying short period occurs in 95 per cent of patients with acute retrobulbar neuritis, regardless of the etiology or of the therapy instituted. Since my residency in Philadelphia I have yet to see acute retrobulbar neuritis due to posterior sinusitis, and I am still convinced that if it occurs its occurrence is rare. In six patients with acute retrobulbar neuritis the recovery of vision was either rapid or followed shortly after medical therapy was instituted. None of these patients revealed any evidence of posterior sinusitis, and none was operated on.

Sinusitis is the last etiologic factor I should consider in a patient with acute retrobulbar neuritis.

DR. H. M. LANGDON: I have seen two patients with retrobulbar neuritis in whom every other examination showed normal conditions, and in each patient operation on a sphenoid sinus was followed by clearing up of the condition and disappearance of the scotoma. One of these patients was observed about seventeen years ago and the other about fourteen years ago, and neither has had any return of the condition. I know that retrobulbar neuritis in many cases turns up later as multiple sclerosis, but as yet neither of these patients has presented any symptoms which could be in any way considered those of multiple sclerosis.

One should not take too firm a stand that retrobulbar neuritis is never due to sinus disease; in a small percentage of cases, I think, it may be.

DR. W. B. DAVIS: There are only two points on which I can add to this very complete symposium. One is the emphasis which is to be laid on the degree of development of the sinuses present in infancy and childhood. The extent of this development is often underestimated.

The other point is the relationship between ethmoidal infection and orbital cellulitis. The fibroperiosteal tissue covering the ethmoidal portion of the orbital wall is always relatively thick; an ethmoidal abscess may separate this thickened layer from the ethmoidal wall, allowing a considerable amount of purulent exudate to accumulate between the fibroperiosteal layer and the bone without the pus actually spreading into the orbital tissues. In this type of condition I have always secured gratifying results by intranasal drainage.

DR. G. M. COATES: It has always been interesting to me to observe the swing of the medical pendulum from right to left or from extreme conservatism to extreme radicalism, and I have been particularly interested in the swing of the pendulum in reference to retrobulbar neuritis in its relation to diseases of the accessory sinuses.

In 1914 the late Dr. Greenfield Sluder stated that there must be hundreds of persons in Philadelphia going blind because they had not had their posterior sinuses properly cared for surgically!

Later I was very much interested in the work of the late Dr. Leon White of Boston. His attitude was at first radical, since he believed, as Sluder did, that retrobulbar neuritis in a large proportion of cases had its origin in infection of the posterior sinuses and that radical drainage was indicated in almost all of these cases. Later on, he became more conservative, believing that more simple, non-operative measures in the nose might often be equally satisfactory, especially when the optic foramen was large and when this could be determined by roentgen study. Still later he believed that infection in dental or tonsillar foci was often more important than disease of the accessory sinuses.

At the time of Dr. White's last paper I talked the matter over with my colleague, the late Dr. Ross Hall Skillern, and we discussed Dr. White's latest stand in detail. At the end Dr. Skillern stated to me that if he was losing vision rapidly he would want his posterior sinuses drained and ventilated immediately in order not to take any chances, even in the absence of symptoms of sinus disease, and that, once this had been done, the rest of the body could be studied for other possible causes of the trouble.

Dr. K. M. Houser: I cannot help but agree with the opinion of Dr. Ross Skillern. Apparently no one knows with absolute accuracy the cause of retrobulbar neuritis. On that occount, if this condition should happen to develop in me and the ophthalmologist was unable to make any progress by treatment, I should wish my sphenoid and posterior ethmoid sinuses to be opened even if no pathologic condition could be demonstrated.

If one cannot make progress by treatment one is certainly justified in this relatively minor surgical procedure. I have seen retrobulbar neuritis in some patients clear up like magic after sphenoidal and ethmoidal surgical intervention, even though the sinuses at the time of operation appeared to be perfectly normal. Instead of waiting indefinitely for other signs of multiple sclerosis to develop and satisfy the diagnosis, why not give the patient the chance which surgical treatment of the sinuses seems to offer at least in certain cases?

BIOCHEMISTRY OF THE LENS

VIII. A NEW PROOF OF THE PRESENCE OF VITAMIN C IN THE CRYSTALLINE LENS

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AND

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In previous reports by one of us (J. B.[1]) the literature concerning vitamin C in the eye was reviewed. It was pointed out that in the normal eye the lens and aqueous are very rich in this substance, that in the cataractous lens the amount of vitamin C is diminished or entirely absent and that the aqueous of an aphakic eye contains only a slight amount of this substance. Experiments were performed which showed a definite reduction in the vitamin C content of the blood in persons with cataract. The crystalline lens was shown to possess a marked preserving action on solutions of vitamin C, whereby oxidation in air is greatly diminished. Furthermore, vitamin C is absorbed from the conjunctival sac into the anterior chamber. Presumably this takes place through the cornea.

In these experiments the amount of cevitamic acid was determined by titration with sodium 2,6-di-chlorobenzenone-indophenol. It has been assumed that the substance in the aqueous and lens which reduced the dyestuff was entirely vitamin C. That this is true under the right conditions will be shown in this paper. Birch and Dann [2] were able to confirm the presence of vitamin C in the lens of the ox by biologic tests by the tooth protection method. It is well known that other substances, such as sulfydryls, are capable of reducing the dyestuff in solutions near the neutral point. In solutions of about p_H 2 the dyestuff was thought to be specifically reduced by the vitamin C of the lens. No proof has been given for this up to the present time. According to Fujita, Iwatake and Miyata,[3] who used Folin's tungstate reagent to

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1. Bellows, John: Biochemistry of the Lens: V. Cevitamic Acid Content of the Blood and Urine of Subjects with Senile Cataract, Arch. Ophth. **15**:78 (Jan.) 1936; Biochemistry of the Lens: VI. Some Studies of Vitamin C and the Lens, ibid., to be published.

2. Birch, T. W., and Dann, W. J.: Biochem. J. **28**:638, 1934.

3. Fujita, A.; Iwatake, D., and Miyata, T.: Biochem. Ztschr. **277**:296, 1935.

determine the vitamin colorimetrically, only 79 per cent of the reduction of indophenol depends on vitamin C, the remainder being brought about by other reducing substances. The results of our work, which are reported in this paper, do not agree with the results of these investigators, for we found that with the right degree of acidity the reduction of the dyestuff is entirely dependent on vitamin C.

The report of Tauber, Kleiner and Mishkind [4] that the pericarp of the Hubbard squash contains an enzyme which is a specific oxidase for vitamin C suggested a new means of proving the presence of vitamin C in the eye. This can take the place of the biologic assay of the vitamin, which is laborious and time-consuming. The ordinary substances present in tissues which interfere with the titration of this vitamin are not affected by this enzyme (Tauber and Kleiner [5]).

Therefore, the amount of dye which is reduced by a given amount of extract is determined before and after action of the enzyme; any difference in the reducing properties is due to vitamin C. The reduction of the dye after action of the enzyme would depend on some substance other than vitamin C; this substance was accepted as vitamin C in previous work. If on the addition of the enzyme the extract no longer reduces the dyestuff, one can state definitely that the entire reduction of the dye depends on the presence of vitamin C in the lens. This, of course, holds true only if the oxidase is entirely specific for vitamin C; according to Tauber and Kleiner, it is. It seems unlikely to us that there would be another substance which reduces the dyestuff at p_H 2 and which would be oxidized by the vitamin C oxidase.

EXPERIMENTS

EXPERIMENT 1.—The purpose of this experiment was to extract the enzyme from the Hubbard squash and to test its effect on vitamin C.

Procedure.—Vitamin C oxidase was prepared from the Hubbard squash by the method outlined by Tauber, Kleiner and Mishkind. We found that the extract of the enzyme loses its potency gradually. At the end of four days its action was greatly diminished.

Vitamin C in crystalline form [6] was placed in test tubes with acetate buffer solutions of varying p_H, and to these the enzyme was added. Table 1 shows the effect of variation of the p_H on the effectiveness of the enzyme. Incubation was carried out at 37 C. for thirty minutes. As controls similar quantities of vitamin C were used with the buffer solution alone.

Results.—As can readily be seen, the enzyme was effective in all ranges from p_H 4.7 to 6, but was most effective at from p_H 5.5 to 6.

4. Tauber, H.; Kleiner, I. S., and Mishkind, D.: J. Biol Chem. **110**:211, 1935.
5. Tauber, H., and Kleiner, I. S.: J. Biol. Chem. **110**:559, 1935.
6. Cebione-Merck was used.

This is in agreement with the report of Tauber and his collaborators. Furthermore, as is well known, vitamin C is oxidized readily in air when in a solution approaching the neutral point and in ordinary distilled water. At all times, however, the loss was much smaller than that in the solution containing the enzyme.

EXPERIMENT 2.—The purpose of this experiment was to determine the true vitamin C content of the lens and aqueous of cattle.

TABLE 1.—*Effect of p_H on the Effectiveness of the Enzyme from Hubbard Squash in Reducing Vitamin C*

p_H	Amount of Vitamin C Added, Mg.	Amount of Vitamin C After Incubation at 37 C. for 30 Min., Mg.	
		With Buffer Alone	With Buffer and Enzyme
4.7	0.083	0.034	0.008
5.0	0.083	0.023	0.005
5.3	0.083	0.020	0.004
5.5	0.083	0.016	0.003
5.8	0.083	0.011	0.000
6.0	0.083	0.007	0.000

TABLE 2.—*Amount of Vitamin C in the Lens and Aqueous of Cattle as Determined by Oxidation by the Enzyme from Hubbard Squash* *

	Cc. of Dye Reduced by	Amount of Vitamin C, Mg. per Gm.
Incubated at 37 C. for 30 minutes		
1 cc. of lens extract	0.645	Lens 0.335
1 cc. of lens extract with buffer alone	0.620	
1 cc. of lens extract with buffer and enzyme	0.000	
Incubated at 37 C. for 30 minutes		
1 cc. of aqueous	4.650	Aqueous 0.199
1 cc. of aqueous with enzyme and buffer	0.000	

* 1 cc. of dye equals 0.043 mg. of vitamin C.

Procedure.—Two lenses of cattle were twice extracted with 10 cc. of a 2 per cent solution of meta-phosphoric acid. The total amount of fluid was centrifugated, and the supernatant liquid was poured off. The sediment was washed thoroughly with the same acid and again centrifugated. The total amount of supernatant fluid was diluted to 50 cc. A 1 cc. aliquot portion was titrated with the dye. Portions of lens extract of 1 cc. were placed in a series of test tubes. To one group 1 cc. each of freshly prepared solution of enzyme and acetate buffer of p_H 5.5 were added. To a second group the buffer solution only was added. At the end of thirty minutes the acidity of the contents of the tubes was brought to p_H 2 by means of sulfuric acid. This was done because previous experiments by us showed that at p_H 5 sulfydryl compounds reduced in dye slowly. This made titration difficult, owing to uncertainty of the end-point. At p_H 2 we found no such interference. The aqueous humor of the eyes of cattle was removed by means of a syringe and was tested in a manner similar to the lens.

Results.—As is shown in table 2, the first group, containing the lens extract with the buffer and enzyme, showed no reducing substance (vitamin C). On the other hand, the group without the enzyme showed a very slight decrease in the vitamin C content. This was to be expected, for, as was shown in a previous report by one of us (J. B.), the lens contains an antioxidative mechanism which prevents the oxidation of solutions of vitamin C in the air. However, this preserving action is evidently not effective in protecting vitamin C against the oxidase enzyme of squash. One may conclude from this that at p_H 2 reduction of the dyestuff by lens extract or by the aqueous is brought about by its vitamin C content.

CONCLUSIONS

An extract from the Hubbard squash contains a powerful enzyme which oxidizes vitamin C. This is a confirmation of the results of the work of Tauber and his collaborators.

The enzyme has its greatest effect between p_H 5.5 and 6.

It was found that the reducing substance in the lens and aqueous that is effective at p_H 2 is entirely oxidized by the enzyme. Since no other substance has yet been found to be so affected, one may conclude that vitamin C is present in the lens and aqueous. The reduction of the dye at p_H 2 is due entirely to vitamin C.

CONJUNCTIVITIS DUE TO FUSOSPIROCHETAL INFECTION

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The literature contains few references to fusospirochetal infections of the eyes, for in general they do not seem to be a favorable site for the development of such lesions. The earliest recorded occurrence of fusiform bacilli in the eye was in a case of metastatic ophthalmitis reported by Bertozzi [1] in 1907. The presence of these organisms in cases of dacryocystitis has been noted by Wakisaka,[2] and by Löhlein.[3] Gifford [4] cultivated them from an ulcer surrounding the canaliculus and also from a chalazion. Fusiform bacilli have produced orbital cellulitis secondary to sinusitis, as has been noted by Kompanejetz [5] and by Seecof.[6] Scholtz [7] found them in a case of gangrene of the conjunctiva secondary to an old injury with a retained foreign body. There are five previously reported cases of conjunctivitis due to fusiform bacilli and spirochetes. In all but one instance the conjunctivitis was unilateral and cleared up without any involvement of the cornea. In one case reported by Goudie and Sutherland [8] there was a severe bilateral purulent conjunctivitis with secondary ulceration of the cornea which resulted in dense leukomas and destruction of vision in both eyes. It is interesting to note that this infection occurred in a poorly developed girl of 14 who resided in a neighborhood where there was an epidemic of "sore throat" (probably Vincent's angina) although negative cultures were obtained from her nose and throat. In two cases (Bowman,[9] Carnot and

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1. Bertozzi, A.: Ann. di ottal. e clin. ocul. **36**:138, 1907.
2. Wakisaka: Klin. Monatsbl. f. Augenh. **8**:797, 1909.
3. Löhlein, W.: Arch. f. Augenh. **89**:201, 1921.
4. Gifford, S. R.: Arch. Ophth. **49**:477 (Sept.) 1920.
5. Kompanejetz, S. M.: Monatschr. f. Ohrenh. **57**:261, 1923.
6. Seecof, D.: Arch. Otolaryng. **10**:384, 1929.
7. Scholtz, K.: Klin. Monatsbl. f. Augenh. **9**:62, 1910.
8. Goudie, W., and Sutherland, J.: Proc. Roy. Soc. Med. (Ophth. Sect.) **6**:142, 1912-1913.
9. Bowman, F.: Lancet **2**:536, 1917.

Blamoutier [10]) the conjunctival infection could be traced to stomatitis caused by the same organisms. In Herrenschwand's [11] case the condition occurred in a physician infected by the saliva of a patient with a dental fistula. The other two cases (Dejean and Temple,[12] Goudie and Sutherland) were apparently instances of primary infection, no focus of origin being found.

Various forms of treatment have been successfully used. Herrenschwand effected a cure in one week with Pregl's solution (a solution of the sodium salt of hydriodic acid and iodic acid with 0.04 per cent iodine), and Dejean and Temple found a 1.5 per cent concentration of zinc sulfate efficacious in their case. For theoretical reasons Smith [13] suggested the local use of a solution of potassium arsenite, supplemented if need be by intravenous administration of arsenic. In our case the local use of a 1 per cent solution of sodium perborate seemed to be of great benefit.

In view of the rarity of reports of fusospirochetal infection of the eye it was considered that the following case would be of general interest.

REPORT OF A CASE

A girl, aged 20, complained of a "cold" in the right eye of two weeks' duration. During that time there had been a purulent discharge which instillations of mild protein silver had failed to check. Examination disclosed a purulent secretion with congestion and thickening of the palpebral conjunctiva and a few enlarged follicles in the lower cul-de-sac. The upper lid was slightly swollen, and there was 2 mm. of apparent ptosis. The cornea was clear, and the lacrimal sac was not involved. The left eye was normal. The eye was treated at intervals of approximately four days with applications of copper sulfate for three weeks without definite improvement. The treatment was then changed to application of a 1 per cent solution of silver nitrate at intervals of about three days for four weeks and application of a 0.2 per cent solution of zinc sulfate three times a day at home; but again there was no change in the condition. As this treatment had failed to produce any definite result and the condition had remained persistently in the one eye, the patient was referred for bacteriologic examinations, which gave the following results: Gram stains of direct films of the secretion showed some polymorphonuclear cells, gram-positive diplococci and gram-negative bacilli. Films of the secretion stained with gentian-violet revealed a number of fusiform bacilli and occasional spirochetes. Dark-field examination of the secretion showed a few spirochetes. Preparations of material from the normal eye showed no organisms. The results of cultures [14] were as follows: Staphylococcus aureus and Corynebacterium xerosis grew in aerobic cultures of the pus on rabbits' blood agar and infusion broth. The same organisms were obtained from the normal eye. Anaerobic

10. Carnot, P., and Blamoutier, P.: Arch. internat. de laryng. **3**:1, 1924.

11. Herrenschwand, F.: Ztschr. f. Augenh. **62**:370, 1927.

12. Dejean, C., and Temple, J.: Ann. d'ocul. **164**:198, 1927.

13. Smith, D.: Oral Spirochetes and Related Organisms in Fuso-Spirochetal Disease, Baltimore, Williams & Wilkins Company, 1932, p. 91.

14. Miss Balbina Johnson aided in the cultivation of these organisms.

cultures in chopped meat broth with ascitic fluid and also in solid proteose agar with the addition of blood yielded the fusiform bacillus in almost pure culture. The organism was not found in cultures of material from the normal eye. An unsuccessful attempt was made to cultivate the spirochetes in Noguchi's medium. It is possible that the failure was due to the very small number of spirochetes present in the pus.

On the basis of this report the treatment was altered to weekly applications of copper sulfate and a 1 per cent solution of sodium perborate used in an eyecup three times a day. The solution of sodium perborate was used because of the beneficial effects of this drug in treating infections of the mouth produced by the aforementioned organisms. As no report of its use in the eye could be found, treatment was begun with a weak solution, and it was planned to vary the strength according to the response. However, this was not necessary, as after three weeks of this regimen there was a marked improvement in the appearance of the conjunctiva and a lessening of the discharge. When last seen, two months after treatment with sodium perborate was instituted, the patient was entirely comfortable, and the eye was practically normal.

SUMMARY

A case of conjunctivitis is described in which the condition apparently was due to a fusospirochetal infection. There was no evidence of such infection in other parts of the body.

Protracted treatment with copper sulfate and a 1 per cent solution of silver nitrate brought no improvement. When application of a 1 per cent solution of sodium perborate was added the condition rapidly improved.

MYOPIA AND ORBITAL CONGESTION

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In the reply to his critics G. Levinsohn [1] repeats his assertions that myopia is due to the effect of gravity in the bent forward position of the head. The eyeball is said to protrude in this posture and to assume a pearlike shape, being similar to a bag of water suspended from a hook, the optic disk being the punctum fixum.

Indeed, the protrusion of the eyeball can be easily verified in many cases. However, this protrusion indicates a forward movement of the eyeball in toto and by no means an alteration of the shape of the eye. It is due to the congestion of the orbital veins. The extent of the protrusion depends on the size of the aperture between the lids, on the resistance of the orbital septum, ligaments, muscles and other structures and on the degree of filling of the orbital veins. If the protrusion were the sequel of an elongation of the eye, there should be an increase of refraction in stooping, a bulging forward and aplanation of the retina round the disk, tension streaks radiating from the disk and an elongation of the macular reflex. The patient should complain of blurred vision. Nothing of this kind happens. I have examined a great number of atropinized and nonatropinized eyes of myopic children both in the upright and in the stooping posture to observe any change which might become visible. The only change I was able to see was a difference in the volume of the venous pulsation. I [2] referred this to differences in the increase of the intra-ocular and the orbital venous pressure. The congestion leads to compression of the nutrient ciliary vessels entering around the optic disk. The retinal vessels are protected by being embedded in the optic nerve. The compression is most effective at the point where the vessels enter the globe, as they are fixed here and cannot evade being pressed against the hard eyeball. As in analogous examples of pressure atrophy, the direct action of pressure on the tissue elements is of less importance than the interference with the blood supply by compression of the vessels. Thus, atrophy of the posterior part of the sclerotic and of the choroid may result and the posterior pole of the eyeball undergo stretching, as it can no longer withstand the normal intra-ocular pressure. This atrophy may be compared with the atrophy of the skin in the presence of varicose veins of the leg. Here, the congestion and swelling of the tissue interfere likewise with the nutrition of the skin and lead to its extreme rarefaction and breakdown. Of course, it is the raised tissue pressure and not the congestion of the veins which brings on these effects. If the eyeball can easily protrude

1. Levinsohn, G.: Reply to Criticisms of My Theory on the Genesis of Myopia, Arch. Ophth. **15**:84 (Jan.) 1936.
2. Lipschutz, H.: Myopia and Nearwork, Brit. J. Ophth. **19**:611 (Nov.) 1935.

owing to an abnormal loose orbital septum or to other moments there will be no considerable rise of the orbital tissue pressure even in cases of orbital venous varicosis giving rise to the symptoms of intermittent exophthalmos. The explanation I have given holds good only for the myopia that is due to passive stretching of the posterior pole. However, there is a myopia which is the result of an active overgrowth and which is characterized by its association with a normal fundus and a normal function. Often, active overgrowth is combined with passive stretching. The genesis of active overgrowth can be considered only under the aspect of heredity. Steiger, who has fully and competently exposed this aspect, has completely disregarded the moments resulting in passive stretching of the eye, i. e., the congestion in the orbit interfering with the ciliary vessels and the acquired weakness of the posterior pole of the sclerotic.

It has to be emphasized that an eye should be regarded as myopic in the biologic sense if the characteristic changes in the fundus are to be seen, even if the actual refraction is normal or hyperopic. In cases of this type the active growth should have resulted in a rather high hypermetropic condition and only passive stretching has brought on a further elongation of the axis. The control of active overgrowth is beyond the scope of hygiene, which may prove to be useful in cases of myopia of the passive and of the combined type.

CONCLUSIONS

1. Axial myopia due to passive stretching of the globe has to be distinguished from axial myopia due to active growth. Both types are often combined. An eye showing myopia due to active growth is myopic only in an optical, not in a pathologic, sense. On the other hand, an eye may be optically emmetropic or even hyperopic while the myopic changes in the fundus reveal that active growth would have produced an eye of a higher degree of hyperopia if there had not been the elongating effect of passive stretching.

2. An inherited or acquired weakness of the sclerotic cannot explain the elective bulging of the posterior pole in an eye myopic through passive stretching, though a general mesenchymal dystrophy may play a rôle as a concurrent factor. This bulging backward of the sclerotic is due to malnutrition caused by the compression of the posterior ciliary vessels which supply the posterior pole. The compression of these vessels is brought on by the orbital venous congestion in the stooping posture of the head. The amount of orbital venous congestion is dependent on various factors, for instance, the development of the anterior venous drainage of the orbit, the size and shape of the orbit, the strength of the orbital septum and the tonus of the muscles (musculi recti, musculus orbicularis) inhibiting a decompressive forward movement of the globe.

CORNEAL DYSTROPHY IN THREE GENERATIONS

WITH A GENEALOGICAL CHART

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In 1890 Groenouw [1] described a slowly progressive degeneration of the cornea consisting of numerous small rounded grayish nonconfluent opacities in an otherwise clear cornea. In 1898 he described the anatomic findings, stating that the condition is a subepithelial degeneration, and in 1917 he reported a series of cases in three generations of a family. Finally, in 1933, he read a paper on a nodular type of corneal dystrophy transmitted through four generations and noted that he had personally examined all four generations of the same family.

Since Groenouw's first description of this disease there have appeared in the literature from time to time reports of other conditions of a similar nature but described under a variety of names, such as corneal nodular opacity, corneal nodular degeneration, familial corneal degeneration, nodular keratitis, lattice-shaped keratitis, hereditary ocular degeneration and reticular keratitis. In reviewing the literature one is impressed with the similarity of the disease process described under these various titles, and it is evident that one is dealing with the same entity. Though the various titles are descriptive of this disease, a common designation, such as familial corneal dystrophy, would, I believe, tend toward simplification and obviate any doubt that one is dealing with a single disease.

The textbooks on ophthalmology give little space to a description of this condition; in fact, some make no mention of it. Fuchs [2] devoted a quarter of a page to the description of a nodular opacity of the cornea, which, he stated, always affects both eyes and occurs mainly in males He stated that these spots are rounded and grayish and of various sizes and shapes, the larger ones occupying the center of the cornea while the smaller are found toward the periphery. The spots are superficial, and the cornea shows elevations corresponding to them. The unevenness of the corneal surface thus produced contributes not a little to the

1. Groenouw, A.: Arch. f. Augenh. **21**:281, 1890; Arch. f. Ophth. **46**:85, 1898; Klin. Monatsbl. f. Augenh. **58**:411, 1917; **90**:577 (May) 1933.

2. Fuchs, E.: Text-Book of Ophthalmology, ed. 8, translated by A. Duane, Philadelphia, J. B. Lippincott Company, 1924, p. 588.

impairment of the sight. Fuchs further described an allied lattice-shaped opacity of the cornea but mentioned that Fehr regarded this disease and nodular opacity as varieties of the same condition. Fuchs claimed that the spots are produced by a deposition of acidophilic substances insoluble in the body fluids in the laminated substance beneath the epithelium and by a basophilic granular substance in the cornea itself.

Brown, in a subsequent translation of Fuchs'[3] textbook, also mentioned that this condition occurs mainly in men and added that, while Groenouw found the grayish spots to be hyaline, Chevallereau found globular crystals of sodium urate.

De Schweinitz[4] described grill-like keratitis or corneal opacity (Haab), nodular or guttate opacities of the cornea (Groenouw and Fuchs) and familial punctate degeneration of the cornea (Fehr). He stated that they constitute a hereditary disease, which appears after the age of puberty. He described the nodes as being beneath the epithelium, raising it and giving the corneal surface an irregular appearance. He mentioned that the condition almost always occurs in men, is not associated with any constitutional disease, affects several members of one family, starts at about the twelfth year of life and progresses steadily until toward middle life.

Ball[5] mentioned nodular keratitis, hereditary degeneration of the cornea, abiotrophy of the corneal nerves, nodular opacity of the cornea and Groenouw's disease. He stated that the condition is found chiefly in young subjects, more often in males. He cited a case reported by Treacher Collins[6] in which the central portion of each cornea was described as showing grayish opacities in the form of twisted lines about 1 mm. in breadth and irregular-shaped dots. The anterior corneal surface was roughened and irregular from the forward pressure of the larger nodules. Ball further stated that the hereditary nature of the disease does not seem to have been noted at first. In 1902 Marcus Gunn[7] reported four cases of this condition in a family of ten. Ball remarked under the heading of prognosis and treatment that nodular keratitis was regarded by Shumway as a hopelessly progressive form of blindness. Leslie Buchanan reported the cases of two brothers in whom the disease apparently was arrested and in whom improvement in vision followed

3. Fuchs, E.: Text-Book of Ophthalmology, translated by E. V. L. Brown, Philadelphia, J. B. Lippincott Company, 1932, p. 212.

4. de Schweinitz, G. E.: Diseases of the Eye, ed. 10, Philadelphia, W. B. Saunders Company, 1924.

5. Ball, J. M.: Diseases of the Eye, Philadelphia, F. A. Davis Company, 1926, vol. 2, p. 492.

6. Collins, E. T.: Tr. Ophth. Soc. U. Kingdom **22**:148, 1902.

7. Footnote 5, p. 97.

iridectomy. A patient treated by Green showed improvement under treatment with tuberculin. C. B. Johnson excised the nodules, with benefit.

Haab [8] described a condition which he termed alphabet keratitis because the corneal opacities presented varying letter-shaped configurations. Later he described a lattice-like dystrophy affecting both eyes, beginning at puberty and accompanied by diminution of vision. In his first cases the patients were members of the same family, a boy of 16 years and his maternal aunt and uncle.

Dimmer,[9] simultaneously with Haab, described a similar entity. He observed three cases, those of two brothers and a sister. He added that the recurrences of inflammation were seen in the first stages of the disease. He considered this to be due to the rubbing of the inner surface of the lid on the cornea. He examined exfoliated particles of the cornea chemically and found a colloid or hyaline substance and triple phosphates. In contradistinction to Haab, Dimmer and others, Parsons [10] stated that there is little inflammatory reaction.

Hine [11] called attention to the relation between familial nodular keratitis and reticular keratitis and reported two cases, one in a girl of 10 years, with vision of 6/12 in the right eye and of 6/9 in the left. The opacity consisted of a number of fine lines, many of which were composed of tiny dots. The lines did not cross but remained separated. One line suggested an obliterated vessel. The other cornea showed a combination of the linear opacities and several small rings. The mother was 36 years old. Vision in the right eye was 6/18 and in the left, 6/12. The central area of the cornea was studded with numerous rather closely set grayish-white opacities, some in the form of rings and some nodular, and in other places the nodules were confluent. The periphery of the cornea was clear.

Wirth [12] reported the results of his histologic examination in a case of nodular keratitis; he observed a hyaline substance. The patient had exophthalmos, tremor and hyperhidrosis, which made Wirth believe that metabolic changes due to thyroid disturbance may be at the bottom of the condition.

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8. Haab, O.: Die Buchstabenkeratitis, Beitr. z. Augenh. **10**:1, 1916; Die gitterige Keratitis, Ztschr. f. Augenh. **2**:235, 1899.

9. Dimmer, F.: Ueber oberflächliche gitterige Hornhauttrübung, Ztschr. f. Augenh. **2**:353, 1899.

10. Parsons, J. H.: Diseases of the Eye, ed. 7, New York, The Macmillan Company, 1934, p. 237.

11. Hine, M. L.: Familial Nodular and Reticular Keratitis, Proc. Roy. Soc. Med. (Sect. Ophth.) **16**:43, 1923.

12. Wirth, M.: Nodular Corneal Opacity, Ztschr. f. Augenh. **58**:106, 1925.

Adrogué,[13] in reporting a case of lattice-like degeneration of the cornea, expressed the opinion that this condition, as well as the nodular keratitis of Groenouw, is a sequel of corneal herpes.

A. Fuchs [14] expressed the belief that lattice-like corneal degeneration descends in a family in a direct line and that it is degeneration of connective tissue without involvement of nerves such as is found in conditions like xeroderma pigmentosum and arteriosclerosis.

Kraupa [15] described the findings in examination with the slit lamp in a case of familial cellular (ichthyotic) dystrophy of the cornea. In the most superficial layers of the cornea were islands of roundish white spots, sharply demarcated from their surroundings; and in the deeper layers were innumerable opacities of the appearance of snowflakes of various sizes with fine irregular processes. The hereditary condition is distinguished from familial neurotic dystrophy of the cornea by the fact that the latter steadily progresses throughout life while in the ichthyotic disturbance the corneal changes are a part of the symptomatology of the cutaneous disorder.

Kraupa [16] and Löwenstein,[17] working independently in the Elschnig clinic, showed that the corneal lesions of this corneal dystrophy represent a transition from the degeneration of the corneal nerves, agreeing with Koby,[18] who stated that in many cases the condition appears to be due to chronic inflammation of the corneal nerves and nodular swelling of the ends of the nerves. On the other hand, Stanka [19] disagreed with Kraupa and Löwenstein. He used a 10 per cent solution of brilliant cresyl to stain the cornea violet-blue and proved thereby that the grill-work was not connected with the corneal nerves.

Paderstein [20] stated that in this disease a degenerative process takes place in the epithelium; the nuclei are destroyed, and the protoplasm is

13. Adrogué, E.: Lattice-Like Degeneration of the Cornea, Rev. Soc. argent. de oftal. de Argentina **1**:32, 1925.

14. Fuchs, A.: Lattice-Like Corneal Degeneration, Ztschr. f. Augenh. **57**:159, 1925.

15. Kraupa, E.: Familial Cellular Ichthyotic and Neurotic Dystrophy of the Cornea, Klin. Monatsbl. f. Augenh. **73**:229, 1924.

16. Kraupa, E.: Die familiären degenerativen Hornhautveränderungen im System der sogenannten Dystrophien der Hornhaut, Klin. Monatsbl. f. Augenh. **70**:396, 1923.

17. Löwenstein, A.: Zur Klinik, Histologie und Therapie der gitterförmigen Hornhautdegeneration, Klin. Monatsbl. f. Augenh. **70**:396, 1929.

18. Koby, F.: Slit-Lamp Microscopy of the Living Eye, Philadelphia, P. Blakiston's Son & Co., 1925, p. 103.

19. Stanka, R.: Familiäre gitterige Hornhautdegeneration, Klin. Monatsbl. f. Augenh. **74**:357, 1925.

20. Paderstein, R.: Bemerkungen zu Wehrli's Kritik meines Falles ven knötchenförmiger Hornhautdegeneration, Klin. Monatsbl. f. Augenh. **47**:604, 1909.

changed into a hyaline substance, which tends to accumulate on the surface of Bowman's membrane.

Ladekarl [21] described two cases of atypical keratitis nodosa Groenouw, with the results of histologic examination. He stated that the condition is chronic and progressive, with pathologic changes in the superficial layers of the cornea, and that it is familial and hereditary. The excised nodes showed histologically thinning of the epithelial layer and flattening of its cells, with vesiculation and vacuolation of the nuclei. Bowman's membrane was frayed or missing in the areas of thinned epithelium. In the superficial layers of stroma two types of changes were present: splitting of the lamellae and transformation to homogeneous masses, probably hyaline, though this could not be demonstrated.

Freudenthal [22] reported two cases of familial corneal dystrophy with generalized degenerative changes and corneal endothelial dystrophy, that of a boy 14 years of age and that of the father, 42 years old. He studied the relation of this condition to the glands of internal secretion. The father had divergent strabismus, with high myopia and astigmatism. He showed signs of hypopituitarism, hypothyroidism and low intelligence. The boy also had divergent strabismus, with a high degree of myopic astigmatism, lowering of intelligence, scoliosis in the lumbar region and hypothyroidism. The mother had dementia praecox. The paternal aunt had congenital syphilis and showed a positive Wassermann reaction. Thus there were three pathologic complexes in the family: endocrine disturbances, degenerative nerve disease and syphilis.

Chou [23] classified the condition by dividing it into three main types: (1) Groenouw's nodular keratitis, characterized by the presence of minute opacities in the central area of the cornea; (2) the Haab-Dimmer type, characterized by the formation of a meshwork of opacities; (3) the Fleischer type, characterized by small ring-shaped opacities occupying the most central portion of the cornea. Chou reported three cases of the Groenouw type and four cases of the Fleischer type.

Chevallereau [24] reported a case of nodular keratitis involving both eyes in a girl of 11 years. He counted thirteen spots in the right eye and seven spots in the left eye, extending across a horizontal band of corneal tissue, a little below the center.

Evans [25] reported the case of a man of 43 years who had had the disease since the age of 14. This patient had a sister who was similarly

21. Ladekarl, P. M.: Acta ophth. **8**:212, 1930.
22. Freudenthal, E.: Ztschr. f. Augenh. **78**:224 (Sept.) 1932.
23. Chou, C. H.: Chinese M. J. **46**:777 (Aug.) 1932.
24. Chevallereau: Nodular Keratitis, Bull. Soc. d'opht. de Paris, 1926, p. 119.
25. Evans, J. J.: Familial Nodular Degeneration of the Cornea, Tr. Ophth. Soc. U. Kingdom **50**:587, 1930.

afflicted. The nodules were found beneath the epithelial layer and in the substantia propria of the cornea. Chance [26] reported a similar instance of familial occurrence of degeneration of the cornea in a man and his son.

Parsons [10] stated that Groenouw's dystrophy occurs as a familial disease, usually affecting the young males of a family and commencing at about the age of 10 or 12 years. There is little inflammatory reaction, and the cause is unknown. He added that the vision is gradually obscured and that treatment is of little avail. In some of these cases examination with the slit lamp shows thickened corneal nerves with nodular swellings of the nerve endings, while in others it shows folds or rupture of Bowman's membrane.

Frykholm [27] reported the incidence of familial corneal degeneration through six generations; the presence of the condition was proved clinically in thirteen members of the last three generations. He described central corneal opacities, which first manifest themselves during puberty and increase progressively until little vision remains. He expressed the belief that the disease is inherited as a dominant trait. Of the forty-two persons in the six generations, eighteen had the disease; seven were males and eleven females. He stated that other authors had reported cases, the majority of the patients being females. He noted that in the younger patients the lattice type of degeneration is usually found, while in the older patients the nodular type predominates. One of the patients had had recurring irritation of the eyes since the age of 5. Srinivasan [28] reported that he had observed a family affected with Groenouw's dystrophy, all the patients being females.

Hager,[29] in outlining the treatment of this disease, stated that she has used Löwenstein's treatment, with good results. This treatment consists of the development of intense hyperemia by daily massage, lasting five minutes, with an ointment containing 3 per cent each of ethyl morphine hydrochloride and mercury, plus heat and diathermy and, once weekly, a large subcutaneous injection of a proprietary solution containing a small amount of iodine and 1 cc. of a 4 per cent solution of sodium chloride. She claimed that vision improved and that the clinical appearance of the cornea changed, the nodes disappearing or becoming smaller.

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26. Chance, B.: Degeneration of the Cornea of a Man and His Son, Am. J. Ophth. **30**:193, 1913.

27. Frykholm, R.: Klin. Monatsbl. f. Augenh. **94**:76 (Jan.) 1935.

28. Srinivasan, E. V.: A Family of Groenouw's Dystrophy, Brit. J. Ophth. **16**:296, 1932.

29. Hager, Lotte: Klin. Monatsbl. f. Augenh. **91**:593 (Nov.) 1933.

Judd [30] reported nine cases of nodular degeneration of the cornea in three generations. Microscopically, he observed that the foreign substance was situated in the superficial layers of the cornea and that the epithelium was occasionally raised above the surface and over the larger nodes. The condition of the direct descendants of one patient in the series suggested pituitary dysfunction. Most of the patients showed thickening of the corneal nerves. He found the disease to be dominant but not sex-linked.

Pillat [31] saw the disease in a 20 year old patient and traced it back to the great-grandfather.

Brav [32] reported five cases, four of which were in females. He described a cobweb-like formation within the superficial layers of the cornea, covering the entire pupillary area, with a clear marginal rim of about 3 mm. He stated that the nodules seemed to be connected by a fine fibrous band, giving the cornea the appearance of a cobweb. Fluorescence produced a faint greenish stain. Three sisters in this group occasionally suffered from photophobia and transitory redness of the cornea. The errors of refraction in his series consisted of mixed astigmatism and, in one case, a high degree of compound myopic astigmatism. All the sisters were married. One daughter, aged 14, had a similar, well marked condition of the cornea. The brother and sisters had the same father and mother. The father married again and by his second wife had three children who were free from this disease, which suggests that the condition came from the maternal side of the family.

Shapira [33] recently reported three cases of this disease in two sisters and in a son of one of them. The son married his first cousin (the daughter of one of the afflicted sisters). The couple had three children, aged 7, 8 and 12 years, who thus far have shown no evidence of the disease. The mother is also free from the disease. Shapira cited Dr. Robert von der Heydt, who has observed several cases over many years, and has made examinations with the slit lamp for the last eight years. He has noted slow progression of the condition. The changes were in the stroma and consisted of a yellowish infiltration of the interlamellar cement substance.

REPORT OF CASES

CASE 1.—Mrs. J. U., aged 70, complained of poor vision, which she noticed was becoming worse rapidly. She said that an aunt (her father's sister) had bad eyes and that her vision could not be improved by glasses. She thought that the

30. Judd, J. H.: Am. J. Ophth. **16**:310 (April) 1933.

31. Pillat, A.: Ueber gitterige und andere Formen degenerativen Hornhauterkrankungen, Klin. Monatsbl. f. Augenh. **69**:682, 1922.

32. Brav, Aaron: Familial Nodular Degeneration of the Cornea, Arch. Ophth. **14**:985 (Dec.) 1935.

33. Shapira, T. M.: Lattice Type of Corneal Dystrophy, Arch. Ophth. **14**:387 (Sept.) 1935.

aunt had a disease of the eyes similar to her own. She was told previously of spots on the eyeball. The first visit was on Oct. 1, 1930. Examination showed both corneas to be covered by an apparent grayish network over the entire pupillary area. A rim of clear cornea was seen at the limbus. On closer inspection rounded spots of various sizes and shapes which appeared to be connected by fine lines were noted. With the corneal microscope one saw rounded grayish spots, which were isolated, and what appeared as fine lines grossly were a series of tiny dots. The spots were beneath the surface and in the superficial layers of the substantia propria. The surface of the cornea was somewhat dull and slightly irregular. There was diminished corneal anesthesia. The tension of both eyes was 25 (McLean). Vision was 20/200 in the right eye and 20/200 in the left; with correction of a high degree of compound myopic astigmatism it improved to 20/100— in each eye. The fundi could not be visualized, but a reflex could be obtained. The lens appeared normal. At a subsequent visit on Nov. 15, 1931, little change was noted. On March 10, 1933, the patient's vision was diminished to 10/200 in each eye, with no improvement by glasses. The corneal spots were denser and more numerous in comparison to their appearance on the patient's first visit to me. On May 12, 1935, the date of her most recent visit, vision was reduced to 5/200, with no improvement from glasses. Dilation of the pupils helped to visualize the lenses, which showed no apparent changes.

Case 2.—Mrs. P. P., aged 65, came on Jan. 15, 1931, at my request for examination of her eyes. I was told that she had the same condition as her elder sister. I found the same corneal disease present. Vision in the right eye was 20/200 and in the left 20/200; with glasses for correction of a high degree of compound myopic astigmatism it improved to 20/70 in each eye. On Dec. 12, 1934, vision was 10/200 in the right eye and 10/200 in the left; with correction it improved to 20/200 in each eye. I treated this patient with a 2 per cent solution of ethylmorphine hydrochloride diluted 1:2,000 in a solution of mercuric cyanide. The treatment was continued until about April 1935, but there was no improvement in the condition.

Case 3.—J. E., a man aged 54, was first seen on Jan. 10, 1920, at which time I found the characteristic spots in both eyes. He told me that he remembered that his parents had good vision. Unfortunately, this patient could not be followed up, for he died one month later of angina pectoris.

Case 4.—Dr. W. F., aged 45, complained of poor vision, which was worse at night, so much so that he could not drive his car. He had acute attacks of severe pain and inflammation in both eyes. These attacks occurred three or four times yearly and had occurred as far back as he could remember. The pain in the eyes was of sufficient severity to unfit him completely for his work for several days. Examination showed the characteristic spots, but in this case they seemed to extend more deeply in the cornea. The cornea had diminished anesthesia; the tension was 30 (McLean) in both eyes. Vision in the right eye was 20/50 and in the left was equal to counting of fingers at 3 feet (90 cm.) with divergent strabismus of about 20 degrees. With correction of myopic astigmatism, vision in the right eye was 20/40, while in the left eye it was unchanged. The fundus of the right eye was normal, and the left eye showed a pale disk. During an attack of pain and inflammation the eye presented the clinical picture of iridocyclitis. There was circumcorneal injection, and a few small deposits were seen on Descemet's membrane; the iris was hyperemic and sluggish. The anterior chamber was unaltered, and no exudate was present. The attack lasted one week. On Dec. 15, 1935, the patient said that of late the attacks of pain and inflammation were less

frequent and were diminished in severity. The poor vision at night was very troublesome. At this time the vision in the right eye was 20/50— with correction. In the left eye vision was limited to counting of fingers at 3 feet. The optic disk in the left eye was still pale and was not greater than in previous examinations. This patient was under treatment with 2 per cent solution of ethylmorphine hydrochloride diluted 1 : 2,000 in a solution of mercuric cyanide for more than two months, with no improvement. The Wassermann reaction and the reaction to tuberculin were negative.

CASE 5.—Mrs. L. L., aged 42, complained of a sensation of sand in the eyes and also of poor vision in the left eye. Examination on April 4, 1930, showed a few small isolated grayish spots in the right cornea and a greater number in the left eye, but this patient showed less involvement of the cornea than any of the other patients. With the corneal microscope the spots were seen to be in the most superficial part of the cornea, beneath the epithelium. The corneal surface was smooth and the sensibility normal. Vision in the right eye was 20/30—, and with correction of a slight degree of hyperopic astigmatism it remained the same. Vision in the left eye was 20/70, with a little improvement by correction of a slight degree of mixed astigmatism. Examination on April 20, 1933, showed a definite increase in the corneal spots of both eyes, with a proportionate decrease in vision. Vision was 20/40— in the right eye and 20/100 in the left, with no improvement by glasses. The fundi of both eyes showed no pathologic change. The eyes were examined while under the influence of homatropine.

CASE 6.—Dr. A. U., aged 37, came on Dec. 30, 1926, for a check on his glasses. This physician, like his cousin, was unable to drive his car at night. Vision was greatly decreased at night. His mother (case 1) had poor vision, but his father had good vision. Examination showed the typical corneal spots, which grossly appeared as a network but on closer inspection were found to be nonconfluent. The corneal surface was slightly irregular and had diminished sensibility. There was a clear rim of cornea of about 3 mm. at the limbus. Vision in the right eye was 20/50 and in the left, 20/40. With a glass to correct a high degree of myopic astigmatism vision was improved to 20/40 in the right eye and to 20/30 in the left. On March 15, 1930, the cornea showed no change. Vision was 20/70 in the right eye and 20/70 in the left, with the same glasses; it was corrected to 20/50 in the right eye and 20/50 in the left. On May 12, 1933, vision was the same with this correction. On Jan. 27, 1936, vision in the right eye was 20/70— and in the left, 20/100; with a further correction of the myopia it was improved to 20/50— in each eye.

CASE 7.—I. U., aged 41, said that he first remembered having poor vision at the age of 21. He always wore glasses. Examination on March 24, 1931, showed the characteristic corneal spots with the clear rim of cornea at the periphery. The vision of this patient was the poorest of the entire group. He could count fingers at 5 feet (152.4 cm.) with each eye. Correction was made for a high degree of myopic astigmatism; vision with the correction was 20/70 in the right eye and 20/200 in the left. The fundus was viewed with difficulty but showed no pathologic changes. The tension was 25 in the right eye and 30 in the left (McLean). On Feb. 10, 1933, the vision was slightly diminished without glasses, and with the same correction as was previously worn it remained 20/70 in the right eye and 20/200 in the left. On Jan. 2, 1936, no change in glass was accepted, but vision was reduced to 15/200 in each eye. At the last visit there were a dull appearance of the cornea and an apparent increase in the number and density of the corneal spots.

CASE 8.—Mrs. R. K., aged 29, came for consultation on June 11, 1927, complaining of pain and redness of both eyes. She had had similar attacks two or three times a year for the past three years. Examination showed circumcorneal injection with a muddy, sluggish iris. The iris easily dilated under the influence of homatropine. There were no exudates or alterations in the anterior chamber. The cornea had a number of small gray spots which were not connected. The margin of the cornea was clear for about 3 mm. Corneal anesthesia was normal. Vision in the right eye was 20/40 and in the left, 20/40; with correction of a moderate degree of myopia with astigmatism it improved to 20/30— in each eye. On July 16 the patient came to the office because of another attack of moderate iridocyclitis, which increased in severity for the next week. The cornea became clouded, and there were signs of a plastic exudate which obliterated a view of the fundus. The tension was 20 in the right eye and 25 in the left (McLean). The iridocyclitis lasted one month, after which the eye returned to its former state. On May 5, 1928, vision was 20/50 in the right eye and 20/50 in the left, and with former correction it improved to 20/40 in each eye. On June 6, 1929, the condition was unchanged. On Sept. 5, 1931, another attack of iridocyclitis occurred, and after this subsided vision was 20/70 in each eye and 20/50 with correction. On Feb. 12, 1933, vision was 20/100 in each eye, and with a stronger correction of compound myopic astigmatism it improved to 20/50—. On Dec. 23, 1935, vision was 20/100 in each eye, and with the same glasses it was 20/70, with no further improvement possible.

CASE 9.—M. U., a man aged 35, came to the office on Nov. 4, 1935, in response to a personal request to examine the condition of the eyes. The familial characteristic spots were present. Vision was 20/50 in the right eye and 20/40— in the left, and after correction of a moderately high degree of compound myopia it improved to 20/30— in each eye. The cornea had diminished sensibility. Tension in each eye was 25 (McLean). The fundi were normal.

CASE 10.—Miss L. U., aged 25, showed on examination the presence of familial corneal dystrophy similar to that in the other cases. Vision in the right eye was 20/30 and in the left, 20/70. Errors of refraction consisted in a small degree of hyperopic astigmatism in the right eye and a high degree in the left, but vision remained unimproved with the correction. Amblyopia ex anopsia was present in the left eye. This patient left town and could not be followed up.

CASE 11.—R. U., 6½ years of age, was sent from school for a test of the eyes. He was first seen on Dec. 30, 1926. The father and the paternal grandmother were afflicted with familial corneal spots. Vision in the right eye was 20/30— and in the left, 20/30—. Retinoscopy showed a slight degree of compound hyperopic astigmatism. With final correction vision improved to 20/20. Both corneas were clear, and the fundi were normal. On Nov. 7, 1929, vision was 20/40 in the right eye and 20/30— in the left, and with the same correction as had been worn previously it improved to 20/20—. Both corneas were clear. On April 24, 1931, examination disclosed no change in the eyes. On May 16, 1932, the patient came for consultation because of a slight abrasion of the lower, outer part of the bulbar conjunctiva of the left eye, following a blow. Both corneas were clear, and refraction was the same as previously. On Feb. 21, 1934, examination disclosed faint vertical streaks in both corneas, which were slightly more marked in the left. The streaks were five in number and converged slightly toward the lower part of the cornea. With the corneal microscope they were seen to consist of rows of tiny dots. They were apparently immediately below the epithelium.

Vision was 20/30— in each eye and could not be improved by correction. The patient was observed regularly until his last visit, on Jan. 27, 1936, when the cornea showed the streaks present exactly as on the first observation, but denser. Vision now is 20/30— in each eye, with no correction accepted.

In reviewing the literature written on this disease and making a study of the case histories, including my own group, one is impressed with the similarity of the descriptions and the agreement as to the anatomic and pathologic findings. However, there is a difference of opinion as to the etiology of the disease.

Several theories have been advanced. Fuchs [34] stated that the condition is a nutritional disturbance. Collins [35] expressed the opinion that it is a neuropathic disorder. Wehrli [36] advanced the theory of tuberculosis, considering it to be lupus of the cornea. Green [37] expressed agreement with this theory. De Schweinitz, in discussing a report of cases of this disorder by Chance,[38] stated that he tried tuberculin in a series of cases over a long period, with no results. Roy [39] stated that consanguinity plays an important part.

No definite etiologic factor of importance was determined in any of the cases of my group. The Wassermann reaction and the reaction to tuberculin were negative. There was no element of consanguinity. In fact, none of the theories advanced seemed to apply to any of the cases in my series. It is also apparent that no successful remedy has as yet been discovered.

The general health and physical condition of all my patients was good. All gave a similar history of unimpaired vision in youth, with the first observation of failing vision at the age of puberty, and from a perusal of the histories it will be noted that failing vision gradually progressed to a state of near blindness in my oldest patient.

Two of my patients had periodic attacks of pain and inflammation in both eyes. These attacks occurred at regular intervals and were of sufficient severity to disable the patients totally. One of the patients can trace these attacks to his youth. The clinical appearance in these cases was that of iridocyclitis, and in one of the cases there were deposits on Descemet's membrane. In the latter case the nodules were located deeper in the corneal stroma than in any of the other cases.

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34. Fuchs, E.: Arch. f. Ophth. **89**:337, 1915.

35. Collins, E. T.: Hereditary Ocular Degeneration, Tr. Internat. Cong. Ophth. **1**:103, 1922.

36. Wehrli, E.: Ztschr. f. Augenh. **13**:322, 1905.

37. Green, J.: Nodular Opacity of the Cornea, with Special Reference to Its Etiology, J. A. M. A. **53**:920 (Sept. 18) 1909.

38. Chance, B.: Nodular Degeneration of the Cornea, Tr. Coll. Physicians Philadelphia **39**:342, 1917.

39. Roy, D.: Report of Six Cases of Degeneration of the Cornea in Same Family, Tr. Am. Ophth. Soc. **13**:101, 1912.

It is the consensus that the nodules consist of a hyaline substance. Goar [40] described an amorphous substance staining yellow with trinitrophenol, resembling hyalin. Weeks [41] cited Fehr as being of the opinion that hyaline masses develop in the superficial lamellae of the cornea, in which crystals of phosphate and sodium urate are subsequently deposited.

It is apparently agreed that the changes in the cornea first manifest themselves at or near puberty. Hine [11] reported a case in a patient aged 10. This seems to be the earliest age recorded. In my group of cases the earliest appearance of the corneal changes was at the age of 13. The patient was first seen by me when he was 6½ years of age and had clear corneas until he was 13. As in Hine's case, my patient showed very fine streaks running in a vertical direction, and under magnification these were seen to be composed of a series of fine dots. This early picture slowly progresses to what one might designate as the mature type, consisting of discrete grayish nodules, grouping themselves in the central portion of the cornea, covering approximately the pupillary area and leaving a clear rim of cornea about 3 mm. wide adjacent to the limbus. Anatomically, it seems to be agreed that the nodules lie below the surface, surely below the epithelial layer, and usually under Bowman's membrane and in the more anterior layers of the substantia propria.

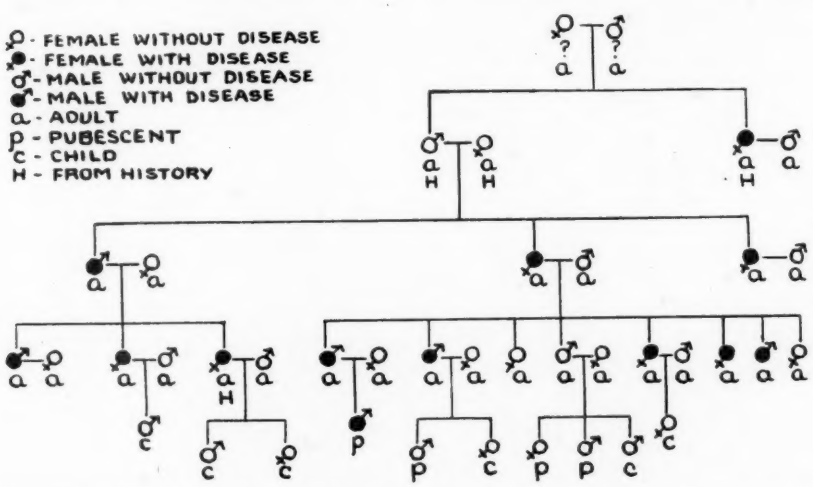
My findings in all the cases in the three generations coincide with those reported by other observers and previously described. Excepting the youngest patient, who showed fine vertical streaks, all my patients showed the nodular form of degeneration, with no trace of any connecting network to resemble the lattice type. The nodules were situated in the substantia propria, beneath Bowman's membrane, extending in one instance as far as Descemet's membrane. The nodules never extended farther than the pupillary area, and a clear rim of cornea about 3 mm. wide could be demonstrated at the limbus in all the cases. What seems to bear out the fact that the condition is progressive is that vision was poorest in the older patients. My records of these cases, extending over a period of ten years, bear out this fact, for it is noted that there was a reduction of vision at each subsequent visit. All my patients required correction for an existing refractive error, and it is interesting to note that in the majority of instances the correction was for a high degree of myopia or of myopic astigmatism or for a combination of both. Freudenthal's [22] and Brav's [32] patients were similarly affected with myopia and myopic astigmatism. Whether this is a family trait or whether it is incidental to the corneal disease remains undeter-

40. Goar, E. L.: Nodular Opacity of the Cornea, Tr. Am. Ophth. Soc. **28**:91, 1930.

41. Weeks, J. E.: Familial Nodular Keratitis, Arch. Ophth. **42**:179, 1913.

mined. Vision in all cases, however, could be but slightly improved by the correcting glass. It is possible, as Fuchs [2] has observed, that the unevenness of the corneal surface may be a contributing factor in the reduction of vision.

In the genealogical chart which includes all the members of this family, both those affected and those free from this disease, it will be noted that the condition was present in both males and females in about equal proportion. It will also be seen that the disease may be transmitted by either males or females. I am in accord with Frykholm [27] and Judd,[30] who stated the belief that the condition is inherited as a dominant trait and that it is not sex-linked. There is no record to date


♀ - FEMALE WITHOUT DISEASE
♀ - FEMALE WITH DISEASE
♂ - MALE WITHOUT DISEASE
♂ - MALE WITH DISEASE
a - ADULT
p - PUBESCENT
c - CHILD
H - FROM HISTORY

Genealogical chart showing the incidence of the corneal disease in the family.

of an instance in which the disease may be transmitted to an offspring by one who is free from the condition.

SUMMARY

A degenerative process of the cornea designated by various names but commonly known as nodular corneal dystrophy is described, with a review of the literature and reports of cases of this condition in three generations of one family. In my work and in the literature there is unanimity on the following characteristics of the disease:

1. Nodular corneal dystrophy is a familial hereditary disease.
2. The disease first manifests itself at or near puberty.
3. Nodular deposits are found beneath the epithelium and in the substantia propria.

4. The nodules are arranged in the center of the cornea, covering the entire pupillary area and never extending to the limbus, allowing a clear rim of cornea about 2 or 3 mm. wide at the periphery.

5. The deposits are noninflammatory, and it is conceded that they consist of a hyaline substance.

6. The disease progresses throughout life, affecting males and females equally.

7. Genealogically, it is a dominant character and is not sex-linked.

8. It is apparently transmitted by those who are themselves afflicted.

9. The etiology is undetermined, and no treatment is of any avail.

10. In the majority of the cases there is myopia or myopic astigmatism or a combination of both.

PHOSPHOLIPID CONTENT OF CATARACTOUS AND SCLEROSED HUMAN LENSES

A BIOCHEMICAL STUDY OF LENTICULAR CHANGES

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In a previous publication [1] it was shown that there is a decrease in the phospholipid content of cataractous lenses, especially in the advanced stages of maturity. Since this is at variance with the older conception, according to which all lipids are supposed to show an increased amount in cataractous lenses, it was considered necessary to repeat the work. At the same time the phospholipid content was studied with respect to sclerosis of the lens.

The word sclerosis in this treatise is used in a more restricted sense than that commonly understood by oculists. It is customary among ophthalmologists to designate by this term simply the general process of hardening of the nucleus incident to growth, aging or pathologic changes, i.e., irrespective of the nature of the agencies involved in this process. It is a generally accepted fact that the nucleus of the lens is the result of a continuous movement of the older cells toward the center. Here they accumulate from year to year, and the nucleus becomes increasingly more dense with age. In time there appears also a faint yellow coloration in the nucleus, which in no wise interferes with its transparency. This is undoubtedly due to the compression of the cells and the accumulation of waste pigments, and not to any degenerative pathologic processes. In the present treatise the word sclerosis is not applied to this condition but is reserved for nuclear changes of a more severe character which are not so much the result of growth and development as an outgrowth of certain degenerations or injuries of tissue. There is, however, no definite line of demarcation between the two types of changes, and in some respects the former may even act as a predisposing factor to the latter. In respect to this Kirby and Wiener [2] made the following statement: "If one compares the chemistry and the structural changes of the normally aging lens with those of certain

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1. Salit, P. W.: Phospholipid Content of Cataractous Human Lenses, Brit. J. Ophth. **19**:663, 1935.

2. Kirby, D. B., and Wiener, R. v. E.: Senile Cataract—A Study of the Biology and Chemistry of the Crystalline Lens, Brit. J. Ophth. **18**:388, 1934.

cataracts, one is impressed with the similarity of many changes, which qualitatively are alike and differ only quantitatively." They also mentioned physiologic nuclear sclerosis that produces presbyopia, in contradistinction to pathologic nuclear sclerosis associated with myopia, nuclear haze and the development of reddish hues or even going on to the formation of the brown and black cataract.

A total of 128 lenses, removed by the intracapsular method, were analyzed. Previous to extraction the stage of maturity was determined by examination with the slit-lamp microscope, and the cataracts were classified into the following three groups: incipient, intumescent and mature. Analysis was carried out in exactly the same manner as described in the previous publication.[1]

The results of the present study fully corroborate those of the former investigation,[1] as well as those obtained by Lavagna[3] with respect to the phospholipid content of cataractous human lenses; mature cataracts,

TABLE 1.—*Minimum, Maximum and Average Values for the Phospholipid Content of Cataractous Lenses in Different Stages of Opacification*

Stage	No. of Lenses	Age of Patient, Years	Duration, Years	Weight of Lens, Gm.	Mg. of Phospholipid per Lens	Gm. of Phospholipid per 100 Gm.
Incipient	79	41–85	0.30–10.00	0.1343–0.2897	0.482–1.774	0.231–0.642
Average		68.9	2.77	0.2009	0.925	0.459
Intumescent	12	44–84	0.67–5.00	0.1825–0.3699	0.432–1.287	0.228–0.537
Average		69.1	2.56	0.2477	0.958	0.391
Mature	37	46–87	1.00–15.00	0.1407–0.2558	0.553–1.205	0.310–0.653
Average		70.6	4.17	0.1946	0.863	0.432

on the average, contain less phospholipid than incipient cataracts, on the basis of both percentage and absolute amount. In table 1 the average value for 37 mature cataracts is given as 0.432 in terms of percentage, or 0.863 mg. per lens in terms of absolute amount, whereas that for 79 incipient cataracts was 0.459 per cent, or 0.925 mg. per lens. The value for 12 lenses with intumescent cataracts was 0.391 per cent, or 0.958 mg. per lens, the extremely low percentage of phospholipids in this group being chiefly due to the increased water content. On the other hand, the high value for the absolute amount, which theoretically should not exceed the value for incipient cataracts, must be due in part to diagnostic difficulties but chiefly to the fact that most lenses in this group, on account of their small number and the wide range of variation in the phospholipid content, happened to fall within the upper limit of values with respect to size. That this is the correct explanation

3. Lavagna, quoted by Lebensohn, J. E.: Biochemistry of the Lens: III. Water Equilibrium in the Normal and Cataractous Lens, Am. J. Ophth. **16**:1062, 1933.

is evident from the extremely high average weight (0.2477 Gm.) of the lenses in this group as compared with that of the lenses with incipient cataracts (0.2009 Gm.) and that of the lenses of mature cataracts (0.1946 Gm.). Such a difference cannot be entirely due to absorption of water. The greater average weight of the lenses with incipient cataracts as compared with that of the lenses with mature cataracts is in accordance with data published previously.[4] This diminution in the weight of lenses with mature cataracts is, at least in part, accounted for by the loss in phospholipids.

In the present study cataract and sclerosis are considered to be more or less related; i.e., they are regarded as two phases of one and the same biochemical process—autolysis. Their relationship is clearly indicated by the following facts: (1) The phospholipid content of highly sclerosed lenses decreases, just as in cataractous lenses, when they approach maturity; (2) cataractous lenses in the mature stage, in which the autolytic processes have spread over the entire lens, practically always contain a sclerosed nucleus, and the sclerosis generally is much more pronounced in this group than in the lenses with incipient cataracts.

In the study of sclerosis the lenses were classified according to stages of development of the sclerotic condition, and the four following groups were compared as to their phospholipid content: 1. Lenses with no perceptible sclerosis. A great many of the incipient cataracts were found to be practically normal with respect to sclerosis. In table 2 this group is designated by 0. 2. Lenses with slight sclerosis. These are designated by +. 3. Lenses with pronounced sclerosis. These are designated by ++. 4. Lenses with highly advanced sclerosis. These are designated by +++. The diagnosis of the stage of sclerosis was made macroscopically. When the lens is spread on filter paper, preparatory to the extraction of lipid, the approximate degree of sclerosis is ascertained by noting the following characteristics: (1) color (the deeper shades of yellow or brown indicating a higher degree of sclerosis) and (2) the relative degree and extent of granulation, soapiness, cheesiness, waxiness, hardness and toughness. The early stages of sclerosis are characterized by the gradual appearance of an amber color in the nucleus. This is soon followed by darkening and wider diffusion of the color and a peculiar mellow and somewhat finely granular appearance of the nuclear tissue, in contradistinction to the pasty consistency of the normal nucleus. This type of change is designated as slight sclerosis. As

4. Salit, P. W.: Calcium Content and Weight of Human Cataractous Lenses, Arch. Ophth. **9**:571 (April) 1933. Salit, P. W., and O'Brien, C. S.: Cholesterol Content of Cataractous Human Lenses, Arch. Ophth. **13**:227 (Feb.) 1935; footnote.[1]

the sclerosis progresses the nucleus becomes larger and takes on a somewhat soapy and cheesy consistency. This condition is designated as pronounced sclerosis. Both types yield readily to pressure, and the nuclei can be spread with ease and uniformity on the filter paper by means of a porcelain spatula. But as the sclerosis advances the nuclear tissue becomes somewhat gluey and in some respects resembles beeswax. At this stage the transformation is accompanied also by marked desiccation and shrinking of the nucleus. Finally the nuclear tissue becomes leathery and unyielding to the attempt to spread it into a uniform layer. The last two changes here described were considered as one stage and designated in the classification as highly advanced sclerosis. Nuclei with this type of sclerosis are met with most frequently in mature and hypermature as well as in morgagnian cataracts; they are next frequent in intumescent cataracts and are extremely rare in incipient cataracts.

Before entering into the discussion of the results of the analysis it is necessary to inquire briefly into the nature of sclerosis in general.

It is conceded that in all types of sclerosis, such as amyotrophic lateral sclerosis, arteriosclerosis, multiple sclerosis and other types, fatty degeneration is the most outstanding characteristic, affecting especially the nervous system. However, opinions vary as to the precise cause of this change. In general, the causes suggested are of two types: (1) hereditary-degenerative and (2) toxic-infectious.[5] Most discussions revolve around the causes of the latter type for obvious reasons. Schükrü [6] quoted Davidson and Hassin as having suggested toxins as the cause. Schükrü attributed the devastating activity to a virus and quoted Steiner, Pette and Osman as being of the same opinion. Margulis [7] likewise belongs to this group. Claude, according to Schükrü, claimed to have produced encephalomyelitis with demyelinization by injecting tetanus toxin. Other investigators, however, have not been able to confirm Claude's findings. Marburg [8] is said to have been the

5. Gerhartz, H.: Zur Pathogenese der amyotrophischen Lateralsklerose und multiplen Sklerose, Med. Klin. **28**:1422 and 1463, 1932; Nachtrag zu meiner Arbeit über die Pathogenese der amyotrophischen Lateralsklerose und multiplen Sklerose, ibid. **29**:223, 1933. Kuhn, P.: Ueber die Spirochäten der multiplen Sklerose, ibid. **29**:950, 1933.

6. Schükrü, I.: Experimentelle Untersuchungen zur Frage der multiplen Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **153**:117, 1935.

7. Margulis, M. S.: Ueber die pathologische Anatomie und Pathogenese der multiplen Sklerose, Deutsche Ztschr. f. Nervenh. **131**:125, 1933.

8. Marburg, cited by Hallervorden, J., and Spatz, H.: Ueber die konzentrische Sklerose und die physikalisch-chemischen Faktoren bei der Ausbreitung von Entmarkungsprozessen, Arch. f. Psychiat. **98**:641, 1933.

first to suggest a lecithinase as the cause. Brickner,[9] who was of the same opinion, carried out a series of experiments in which he definitely proved the presence of an abnormal type of lipase in the blood of patients with multiple sclerosis; this lipase was capable of decomposing lecithin. Brickner's findings have been confirmed by the joint work of Crandall and Cherry[10] and also by the joint work of Weil and Cleveland.[11] They have also been confirmed indirectly by the favorable results that have been obtained by a few investigators, especially Weinberg,[12] by intraspinal injections of emulsions of lecithin in multiple sclerosis.

The results of the present work on lenticular sclerosis are in harmony with the findings of Brickner concerning multiple sclerosis and agree indirectly with those of Weinberg. It is therefore certain that the pathologic lenticular changes in advanced age are initiated by disturbances in the fat metabolism, specifically by those affecting the phospholipids.

It may be of some value to formulate a theory, as a basis for further investigations, with respect to the precise biochemistry of the process resulting in nuclear sclerosis and other lenticular changes. Let it be assumed that the enzymes are more or less powerless to invade or attack healthy, normal tissue, and that they become dangerous only when aided by various injuries to the lens, such as those resulting from a blow on the eye, prolonged exposure to intense heat or to ultraviolet rays, electric shock, faulty metabolism and diabetes or other severe general diseases. In order to explain the precise nature of such damages one must inquire briefly into the biochemical make-up of the lenticular tissue. Above all the fact must be stressed that biochemical studies have revealed the existence of substances of complex molecular structure, such as lecithoproteins, cholesterol proteins and lecithocholesterol, the component parts of which are said to be somewhat loosely bound together. According to statements made frequently in the textbooks of biochemistry, lecithoproteins are found to be regular constituents of cytoplasm and limiting membranes. Since the crystalline lens is similar

9. Brickner, R. M.: Studies of the Pathogenesis of Multiple Sclerosis: II. Evidence of the Presence of an Abnormal Lipase in the Blood in Multiple Sclerosis, Bull. Neurol. Inst., New York **1**:105, 1931; III. Further Evidence of Abnormal Lipolytic Activity in the Blood in Multiple Sclerosis, ibid. **2**:119, 1932.

10. Crandall, L. A., and Cherry, I. S.: Blood Lipase, Diastase and Esterase in Multiple Sclerosis: A Possible Index of Liver Dysfunction, Arch. Neurol. & Psychiat. **27**:367 (Feb.) 1932.

11. Weil, A., and Cleveland, D. A.: A Serologic Study of Multiple Sclerosis, Arch. Neurol. & Psychiat. **27**:375 (Feb.) 1932.

12. Weinberg, M. R.: Lecithin Treatment of Some Multiple Sclerosis Syndromes, J. Nerv. & Ment. Dis. **79**:264, 1934.

to such tissues, one may postulate that it likewise contains lecithoproteins.

Krause [13] also pointed out that the cholesterol in the lens tissue appears to be associated with the phospholipids. Such a combination of cholesterol and phospholipid has been actually demonstrated by Handovsky [14] in serums of the ox. He stated that from 20 to 30 per cent of the cholesterol of normal ox serums is bound with globulin and that the rest, from 70 to 80 per cent, is combined with phospholipids. When the serum protein was precipitated, either by being heated with dilute acetic acid or by treatment with a saturated solution of ammonium sulfate, all the phospholipids were found to be in the filtrate, and along with them was from 70 to 80 per cent of the total cholesterol content. In fact, cholesterol as such is insoluble in water and must be attached to some emulsifying agent, such as the phospholipids, in order to be of any use to the tissue. As regards the existence of a cholesterol-globulin complex, which Handovsky mentioned, there does not seem to be the least doubt. Bang [15] was the first to show that the cholesterol of ox serums may be in combination with proteins, most probably the globulins. This has been corroborated also by the joint investigations of Handovsky, Bosse and Lohmann,[16] by the experiments of Gardner and Gainsborough,[17] and by those of Waker and Hueck,[18] and a few other investigators. Likewise, Krause,[19] who investigated the lipid content of the vitreous humor of normal ox eyes, found a part of the cholesterol and other lipids to be bound to the proteins. And it would be strange

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13. Krause, A. C.: Chemistry of the Lens: VI. Lipids, Arch. Ophth. **13**:187 (Feb.) 1935.

14. Handovsky, H.: Untersuchungen über die Zusammensetzung des Blutserums und ihre Bedeutung für Giftwirkungen, Arch. f. d. ges. Physiol. **210**:35, 1925.

15. Bang, I.: Ueber Lipämie, Biochem. Ztschr. **90**: 383, 1918.

16. Bosse, P., and Handovsky, H.: Untersuchungen über die Zusammensetzung des Blutserums und ihre Bedeutung für Giftwirkungen: II. Charakterisierung der Eiweissfraktionen des normalen Serums durch die Viscosität, Arch. f. d. ges. Physiol. **210**:50, 1925. Bosse, P.: III. Die Werkung von Aether auf Serum, ibid. **210**:56, 1925. Handovsky, H., and Lohmann, K.: IV. Methode zur Bestimmung des Cholesterins im Blutserum, ibid. **210**:59, 1925. Handovsky, H.; Lohmann, K., and Bosse, P.: V. Untersuchungen über den Zustand des Cholesterins im Blutserum, ibid. **210**:63, 1925.

17. Gardner, J. A., and Gainsborough, H.: Studies on the Cholesterol Content of Normal Human Plasma: II. Biochem. J. **21**:141, 1927.

18. Waker, L., and Hueck, W.: Chemische und morphologische Untersuchungen über die Bedeutung des Cholesterins in Organismus, Arch. f. exper. Path. u. Pharmakol. **74**:416, 1913.

19. Krause, A. C.: Chemistry of the Vitreous Humor: III. Lipids, Arch. Ophth. **13**:1022 (June) 1935.

if such a compound were absent in the lens, which is a more highly organized tissue than the serum and greatly resembles the vitreous humor.

According to the descriptions of these investigators, the connection between the cholesterol and the globulin seems to be extremely loose. Handovsky, for instance, stated that from 16 to 50 per cent of the cholesterol could be separated by simply shaking the serum with ether for six hours. The treatment, he pointed out, does not denature the protein, which means that the separation was accomplished solely by physical means. One may therefore assume that similar cleavages will occur in the lens tissue following an electric shock, prolonged exposure to ultraviolet or infra-red rays, faulty metabolism, certain infectious general diseases, etc. This process of division naturally increases the number of molecules in the affected part. And physical chemistry teaches that all particles or molecules have great affinity for water and in the latter's presence endeavor to clothe themselves with an envelop of this medium. This phenomenon is sometimes spoken of as molecular imbibition of water. There is also capillary imbibition of water, which occurs as a result of cleavages or ruptures in the tissue. Furthermore, it is possible that at certain stages of autolysis of tissue the resulting products exhibit stronger hydrophilic properties than the original normal tissue. In fact, autolyzing tissue is known to show much greater affinity for water than can be accounted for merely by the molecular and the capillary imbibition of water. It is therefore to be expected that any serious injury to the lens that results in the dissociation of the molecular complexes will be followed by intumescence. And the injured part will then also become more accessible to enzymes. If these enzymes happen to be already in the aqueous humor, following certain local or general diseases, a vicious circle of tissue destruction is started. Enzymes are specific in their actions; it is possible that there is a special lipase, a lecithinase, that acts only on lecithin and only on its free form and that it ignores this lipid when it is in combination with some other substance. This, of course, must apply also to the proteolytic enzymes. If such were not the case there would be danger of certain living organs being digested by the enzymes that they produce, just as the same organ tissue is acted on when it is ingested. The lecithin and the other moieties that happen to be liberated by the agents just described undergo a further process of disintegration, increasing the number of particles or molecules within the lens tissue, thus causing the lens to swell further.

Von der Heydt [20] regarded sclerosis and intumescence as two independent processes, the one affecting chiefly the nucleus and the other the cortex, in a way inhibiting each other. From the physical stand-

20. von der Heydt, R.: The Aging Lens, Am. J. Ophth. **18**:545, 1935.

point and when sclerosis and intumescence are viewed not as processes but as states or products, these two lenticular changes are diametrically opposed; biochemical studies, however, reveal them to be related as the solid and liquid phases are related in the mixture that results from heating clabbered milk. In the lens naturally the biochemical processes are infinitely more complex and extend over a long period of time. An interrelationship between the various manifestations of lenticular changes, autolysis being at the bottom of it, was also pointed out by Lebensohn,[21] who stated: "The water changes and all other deviations noted in the biochemistry of senile cataract are explainable simply as a result of processes conditioning, involving, or ensuing from autolysis." This relationship he stressed again in his recent publication on the mineral metabolism in the normal and in the cataractous lens, in which he stated: "Cataractous degeneration, so far as may be determined from the mineral analysis, is a diffuse process; in the cataracts that come to operation, cortex and nucleus seem about equally involved." [22]

Cataract is found chiefly in the cortex or the softer and more hydrophilic parts of the lens tissue; sclerosis occurs chiefly in the nucleus or the harder parts of the lens tissue. Cataract, therefore, represents changes chiefly in the crystallins, while sclerosis is characteristic of changes in the albuminoid and lipids. Any pronounced dissociation between the chief components of the complex molecules in a more or less fluidic medium, such as the water-soluble crystallins of the cortex, will lead much more easily to displacements or disarrangements in the architectural elements of the tissue than when such changes occur in a more solid mass, such as the water-insoluble albuminoid nucleus. Hence a lens may be highly sclerosed and yet permit light to pass through, whereas a much lesser disturbance in the softer parts of the lens tissue results in opacities.

Individual lenses of the same general appearance differ greatly in their phospholipid and cholesterol contents. They differ likewise with respect to the relative amounts and distribution of their soluble and insoluble proteins. One must therefore expect to find similar variations in the pathologic pictures of different lenses. Thus, some lenses show high sclerosis of the gluey or waxy type but only a slight opacity in the cortex; in some the sclerosis involves the largest part of the lens and is more of the mellow, granular or soapy type, with a light yellow tinge; in others the cortex is almost liquefied and the nucleus is small,

21. Lebensohn, J. E.: The Biochemistry of the Lens: III. Water Equilibrium in the Normal and Cataractous Lens, Am. J. Ophth. **16**:1062, 1933.

22. Lebensohn, J. E.: Biochemistry of the Lens: VI. Mineral Metabolism in the Normal and in the Cataractous Lens, Arch. Ophth. **15**:217 (Feb.) 1936.

shrunken, deeply colored and extremely hard, while in still others practically the entire lens has been converted into a jelly-like consistency.

In general, nuclear sclerosis is regarded as a normal process accompanying age. Such, indeed, it is, since age is the accumulative result of all the damaging influences incurred during life, leading to gradual disintegration of tissue. A few of the adverse factors leaving their impress on the lens already have been pointed out. Some of these factors are accidental; others, such as radiation of light, disturbances in the general metabolism, various toxins, a vitamin-deficient diet and various general diseases, are more or less a part of the daily environment. Under the constant impact of these influences, however mild, more and more of the complex molecules will break down into two or more parts, i.e., into some free cholesterol, phospholipid, protein, etc.

TABLE 2.—*Minimum, Maximum and Average Values for the Phospholipid Content of Cataractous Lenses in Different Stages of Sclerosis*

Stage*	No. of Lenses	Age of Patient, Years	Duration, Years	Weight of Lens, Gm.	Mg. of Phospholipid per Lens	Gm. of Phospholipid per 100 Gm.
0	26	42–81	0.33–7.00	0.1426–0.2259	0.627–1.393	0.305–0.627
Average		61.4	2.35	0.1918	0.926	0.494
+	31	41–83	0.50–5.00	0.1343–0.2963	0.432–1.773	0.228–0.612
Average		67.2	2.37	0.2160	0.925	0.430
++	33	57–84	0.42–10.00	0.1617–0.3699	0.606–1.424	0.254–0.563
Average		72.6	2.91	0.2172	0.927	0.417
+++	38	46–87	1.00–15.00	0.1407–0.2638	0.553–1.435	0.310–0.653
Average		71.8	4.41	0.1959	0.877	0.449

* 0 indicates "practically normal" lenses; +, slight sclerosis; ++, pronounced sclerosis, and +++, highly advanced sclerosis.

And since the nucleus is said to contain more of these lipid complexes the process will affect chiefly this part. But these fragments are still relatively large colloid molecules and will stick together mechanically in the same spatial relationship as before and thus present little or no obstruction to the passage of light. In the absence of more violent disturbances this relatively mild process of disintegration may go on indefinitely without seriously disturbing the architectural unity, the crystalline structure, of the lens, and the latter will retain its transparency.

RESULTS OF EXPERIMENTS ON SCLEROSIS

It is seen from table 2 that the percentage of phospholipids decreases with advancing sclerosis up to the third stage, the average value for 26 practically normal lenses being 0.494 per cent, that for 31 slightly sclerosed lenses being 0.430 per cent and that for 33 lenses with pronounced sclerosis being 0.417 per cent. In the last stage, or highly advanced sclerosis, the average percentage of the phospholipids again

shows an increase but does not reach that of "practically normal" lenses, 38 lenses showing an average of 0.449 per cent. The absolute values for phospholipid, however, are seen to remain the same in the first three groups but show a considerable decrease in the last stage of sclerosis, the average values being 0.926, 0.925, 0.927 and 0.877 mg. per lens, respectively. The decrease in percentage up to the third stage inclusively was due solely to the increase in the weight of the lens; the average weight in the first stage was 0.1918 Gm.; in the second, 0.2160 Gm., and in the third, 0.2172 Gm. This increase in weight is directly proportional to the degree of sclerosis and must be attributed either to the increase in certain solids other than phospholipids or to the absorption of water. The fact that there is a sudden stop in the increase in weight, followed by a marked decrease before the sclerosis has come to its fullest development, suggests a process of swelling. Molecular imbibition of water can continue only as long as the fragments, the result of autolysis, are too large to pass through the limiting membrane, the capsule. But eventually they become smaller and smaller; the capsule, under the stress of internal pressure, becomes more and more distended and porous, and a stage is reached when the contents of the lens begin to diffuse into the aqueous and vitreous humors.

On examining the data for the absolute amounts of phospholipids in the lenses in table 2 one becomes aware of an apparent inconsistency. It is argued that there is a gradual destruction of phospholipids, and yet the amount of these lipids is shown to remain constant during the first three stages. The reason for this lies in the indirect method of estimation of these lipids; i.e., it was the phosphorus content of the lipids that was estimated, and from this the phospholipid content was calculated in terms of lecithin.[23] Therefore, a decrease in the phospholipid content is indicated only at a stage when the phosphorus-containing fragments are small enough to pass through the capsule. This decrease is by no means a measure of the amount actually destroyed but indicates only the amount of lipid phosphorus retained within the lens, whether in the form of detritus or still as a part of the normal tissue. Therefore, the actual destruction must be many times larger than is indicated by the figures.

The data in table 3, which are arranged according to age in decades, corroborate the results previously published.[1] This table shows an increase in the phospholipid content with advancing age on the basis of both percentage and absolute amount. The phospholipid content of a normal lens from an 18 year old girl was found to be 0.409 per cent. In the fifth decade the average value for 7 cataractous lenses was 0.438 per cent, and that for 17 lenses in the sixth decade was 0.441 per cent. In the seventh decade, however, one finds a low figure, an

23. The details of the method were described in an earlier publication.[1]

average of only 0.428 per cent for 39 lenses. This group of lenses happened to contain the highest percentage of those with mature cataracts as well as those with highly advanced sclerosis, and this is the reason for the anomaly. In the eighth decade there is again an increase, the average value for 45 lenses being 0.448 per cent. Likewise, the average value for 19 lenses in the ninth decade shows an increase to 0.478 per cent. Similar although less pronounced increases are shown in the absolute values for phospholipids, with the exception of those for the seventh decade, which has already been discussed, and that for the normal lens for an 18 year old girl. This lens showed a higher value than the average for the fifth decade, i.e., 0.696 mg. per

TABLE 3.—*Minimum, Maximum and Average Values for the Phospholipid Content of Cataractous Lenses According to Age in Decades*

Decade	No. of Lenses	Age of Patient, Years	Duration, Years	Weight of Lens, Gm.	Mg. of Phospholipid per Lens	Gm. of Phospholipid per 100 Gm.
II	1	18	Normal	0.1705	0.696	0.409
V	7	41–46	1.00–10.00	0.1426–0.2085	0.432–0.854	0.228–0.598
Average		43.7	3.45	0.1709	0.677	0.438
VI	17	50–59	1.00–7.00	0.1343–0.2563	0.511–1.154	0.344–0.553
Average		55.6	2.65	0.1970	0.870	0.441
VII	39	60–69	0.50–15.00	0.1407–0.2558	0.566–1.287	0.286–0.576
Average		66.1	3.39	0.1975	0.844*	0.428*
VIII	45	70–79	0.33–8.00	0.1517–0.3699	0.627–1.435	0.274–0.673
Average		74.5	3.10	0.2122	0.939	0.448
IX	19	80–87	0.50–10.00	0.1760–0.2963	0.606–1.774	0.313–0.627
Average		82.0	5.35	0.2194	1.058	0.478

* This group happened to contain the largest percentage of mature cataracts, which accounts for the lower values.

lens, as compared with 0.677 mg. This must be due either to the fact that normal lenses on the average contain more phospholipids than cataractous lenses or the fact that this lens happened to fall in the upper limit in regard to values. The other values were as follows: sixth decade, 0.870 mg. per lens; seventh decade, 0.844 mg. (this value is low for reasons which have already been discussed); eighth decade, 0.939 mg.; ninth decade, 1.058 mg.

When one examines the average weights of the lenses of patients of the different age groups (table 3) one likewise notices, in agreement with data in previous publications,[4] an increase parallel to age. The average weights for the respective decades were: second decade, 0.1705 Gm.; fifth decade, 0.1709 Gm.; sixth decade, 0.1970 Gm.; seventh decade, 0.1975 Gm.; eighth decade, 0.2122 Gm.; ninth decade, 0.2194 Gm.

SUMMARY

The phospholipid content of each of 128 human cataractous lenses was determined by a modification of Whitehorn's colorimetric method by which the value for lipid phosphorus is estimated and from this the phospholipid content is calculated indirectly as lecithin. By this method one is not able to detect any changes that might occur in the phospholipid molecule as a result of decomposition as long as the phosphorus-bearing fragments remain within the lens. But when the disintegration of the phospholipid molecules has gone so far that their fragments begin to diffuse through the capsule of the lens one is able to estimate the loss accurately. For obvious reasons a loss in the content of the lenticular lipid phosphorus, however small, can occur only after the process of disintegration has become far advanced.

All the lenses were extracted by the intracapsular method after examination with the slit-lamp microscope and classification according to stages of development of the cataract. Preparatory to the extraction of lipid, in which the lens was spread on a piece of filter paper by means of a porcelain spatula, the lenses were examined also with respect to the degree of sclerosis. They were classified also according to age, and in each case the duration of the cataractous condition was noted.

Pathologic lenticular sclerosis and cataracts appear to be more or less related, both being due to disintegration of the lens tissue or autolysis. The first process represents chiefly changes in the insoluble albuminoid and lipoid nucleus; the second is characteristic of changes in the cortex, which consists largely of water-soluble crystallins. The phospholipid content of highly sclerosed lenses decreases just as in cataractous lenses when they approach maturity. Cataractous lenses in the mature stage, in which the autolytic processes have spread over the entire lens, practically always contain a sclerosed nucleus, and the sclerosis generally is much more pronounced in this group than in the lenses with incipient cataracts. A highly liquefied cortex, as a rule, is accompanied by a hard, desiccated nucleus.

It is pointed out that the lenticular tissue is very likely composed of substances of highly complex molecular structure, such as cholesterol proteins, lecithoproteins and lecithocholesterol, and that the connections between the two or more component molecules are relatively weak. Under the constant impact of certain disturbing agencies, such as ultraviolet and infra-red irradiation, faulty metabolism, severe general diseases and various toxins, cleavages of a more or less permanent nature are produced in these chemical complexes. The proteins, especially the insoluble albuminoids, and the cholesterol, thus being freed from their emulsifying agent, the phospholipids, give rise to sclerosis. Depending on the mildness or severity of the destructive

agencies, the architectural unity of the crystalline lens may remain intact for years and thus retain its transparency in spite of advanced sclerosis, or it may become seriously impaired and, in conjunction with autolysis and molecular and capillary imbibition of water, produce displacements in the structural elements and their interfaces and thus give rise to various opacities.

In agreement with previous observations it was found that the phospholipid content of the lens increases with age, both in percentage and in absolute amount. Increases in the weight of the lenses with advancing age were also noted, thus corroborating earlier findings.

Dr. C. S. O'Brien, head of the department of ophthalmology, gave valuable help throughout this work.

Ophthalmologic Review

THE SPECTACLE INDUSTRY

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The professional detachment of the ophthalmologist from the commercial and technical phases of the spectacle industry may well be replaced by a wider outlook. Perhaps this traditional attitude has been subtly fostered by the commercial interests involved to forestall unwelcome criticism. Though the scientific contributions of the leading concerns are worthy of serious study, the industry still has certain tendencies toward mystery, pretense and commercialism which the profession should be alert to penetrate. The absurd claims made in the advertising of tinted glasses and various patented lenses have been adequately exposed by Jackson,[1] Coblentz[2] and Cowan.[3] Said Jackson: "When tinted glasses are necessary, London Smoke Nos. 1, 2, and 3 are better than many that are said by their makers to perform miracles. The 'soft light' of a cathedral is a poor light for ordinary purposes."[4] Coblentz stated: "Lenses in which the tint is invisible except when viewed edge-on are no more useful in reducing glare than common window glass." Cowan, after pointing out that the most accurate ophthalmic

From the Department of Ophthalmology, Northwestern University Medical School.

1. Jackson, E.: Report of Committee on Optics and Visual Physiology, J. A. M. A. **101**:278 (July 22) 1933.

2. Coblentz, W. W.: Tinted Lenses, J. A. M. A. **102**:1223 (April 14) 1934.

3. Cowan, A.: Patented Lenses, J. A. M. A. **103**:1377 (Nov. 3) 1934.

4. Confused thinking in regard to tinted lenses has resulted from improper analysis of the various terms used: "dazzling," "retinal hyperesthesia," "protection," "glare," and "photophobia." Dazzling occurs whenever the intensity of visual rays is not overcome by ocular adaptation. The dazzling of retinal hyperesthesia is associated with inadequacy of normal adaptation. Protection is required from the pathologic effects of harmful ultra-violet or infra-red rays. Glare is caused by excessive contrast between illumination in the central and that in the peripheral field. Photophobia, however, is based on pathologic conditions in the eye (Lebensohn, J. E.: The Nature of Photophobia, Arch. Ophth. **12**:380 [Sept.] 1934). As to tinted glasses to reduce dazzling—the most general need—Jackson's statement is authoritative. It is only for occasions requiring exposure to biologically dangerous rays that special appropriate screening lenses are requisite. As a remedy for glare or photophobia tinted lenses are useless.

lens possible would still be a compromise, continued that nevertheless "certain manufacturers imply in their advertisements that they, and only they, have the ideal ophthalmic lenses—corrected to the very edge for both the error of marginal focal power and the astigmatism of oblique pencils, even in bifocals. What is most glaring is that while no two of the many patented forms are alike, each is claimed to be perfect." Though such extravagances are to be discounted, the refractionist interested in the coflexures of his prescription will find that in the higher plus compounds the newer forms of ophthalmic lenses represent a definite advance over the curves formerly procurable.

INDUSTRIAL DATA

The Better Vision Institute, to the president of which I owe some of the data which follow, is the organization representing the optical industry as a whole. Its board of directors includes manufacturers, wholesalers, dispensing opticians and optometrists in equal numbers. Being a business enterprise, it does not include ophthalmologists, whose interests are considered to be guarded by the dispensing opticians. Its purpose is primarily promotional—to develop "eye consciousness" in the public. The policy is to keep propaganda neutral and avoid criticism from either ophthalmologists or optometrists. Among other activities are radio broadcasts by celebrities, the putting out of safety posters, school campaigns, consumer surveys and promotion of styles. Over three million booklets have been distributed. To overcome prejudice against the wearing of glasses, noted artists have shown how glasses can emphasize any desired quality in one's appearance, such as dignity, intellectuality, sophistication, poise, prestige. For the woman who hesitates whether to see well or to be seen well, beauty hints are given as to the proper make-up and hat models that most effectively go with glasses. The institute's recent devotion to the "Better sight—better light" campaign represents a tie-up of the electrical, paint and optical industries which, though inspired by profit, is not without a scientific basis.

The value of the total retail optical business during a normal year is over $100,000,000, which is one fifth of the amount spent for toilet preparations and one thirty-fifth of that spent for tobacco. The product is priced at the factory at one fifth of this sum, the difference being the expenses and profit of wholesalers and dispensers. The wholesalers are in two groups—independents and those controlled by manufacturing corporations. To furnish a year's lenses, 50,000 tons of optical glasses are required. American optical products are distributed extensively abroad except in Germany and Japan; from these two

countries our imports are considerable while our exports to them are practically nil. Crookes glass, which was developed in England, is still being imported, though some is manufactured here.

There are 10,000 oculists and 22,000 registered optometrists in the United States. The optometrists fit about 60 per cent of the glasses; oculists, 30 per cent; department and chain stores, 10 per cent. Although surveys indicate that 70 per cent of adults need glasses, only 30 per cent have them, and half of these use them for close work only; 35 per cent wear bifocals; 7 per cent, tinted lenses. The average interval between examinations is from four to five years. In a recent British study Harman [5] found that of 10,000 persons whose refraction was studied 29 per cent had in addition to refractive errors one or more other ocular conditions and that of those referred for refraction 6 per cent did not require glasses.

REFRACTING OPTICIANS

Before Donders' work refraction as well as lens grinding was the recognized field of opticians. The developing interest of oculists in refraction resulted in a realinement into dispensing and refracting opticians. The refracting opticians for the most part had but rudimentary knowledge and peddled spectacles in the blantant fashion which is still too familiar. The optician Charles F. Prentice, however, because of superior educational attainments, considered himself entitled to a fee for his service. Noyes warned him to abandon this practice, writing "You assume a responsibility for which you have no legal license, while without the fee the patient takes the responsibility." Prentice therefore determined to get legal recognition. The term "optometrist" originated with the state senator from Rochester, N. Y., who sponsored the bill. The first optometry law, that of the state of New York, was passed in 1908. Since then every state in the union as well as every province in Canada has enacted legislation regulating optometry. Though England does not give legal recognition to the refracting optician, fellowship in a recognized organization is regarded as qualifying.

The following universities have established schools of optometry: Columbia University College of Physicians and Surgeons, University of Rochester School of Medicine, Ohio State University College of Medicine, University of Illinois College of Medicine, University of Southern California School of Medicine, and University of Montreal Faculty of Medicine.

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5. Harman, H. B.: The Findings of Eye Examinations, Brit. M. J. (supp.) **2**:181 (Oct. 6) 1934.

The requirements for obtaining a license vary, being highest in the state of New York, which requires a bachelor's degree and graduation from a school of optometry conducted as a department of a recognized university.

Optometrists are classified as commercial or professional. The latter, the "upstairs men," maintain offices, not stores, and frown on display advertisements, handbills and the advertising of prices. But, as regards the former, "Optical advertising still leads in the number of inaccuracies per inch of copy of all classes of advertising appearing locally."[6] This "bait" advertising is so worded as to mean one thing to the customer at first and something else later. Buried in the text appear the apparently meaningless words "finest spherical lenses." The investigators for the Chicago Better Business Bureau found that nine of ten customers were unable to get glasses at the advertised price.

The general ignorance in regard to glasses is illustrated by the broadcaster who on Sunday, March 3, 1935, appealed to the public to send old or discarded spectacles for distribution among the poor.[7] The Chicago concern which advertised mail order fitting of spectacles profited on human credulity by an annual million dollar turnover for nearly fifteen years.[8] Mark Twain was right: "The absurdity that the human race won't swallow hasn't yet been invented."

Post[9] does not expect too much from legislation: "There seems to be a way to circumvent the intention of almost every law, good or bad. For example, at the present time in some states in which are rigid laws prohibiting the measuring of eyes for lenses by the untrained, the individual is allowed to test his own eyes for lenses at the counter of a department store."

DISPENSING OPTICIANS

A law recently passed by the state of Connecticut to control the sale of optical goods requires (1) that all dispensing opticians be licensed and (2) that concerns selling optical merchandise other than that based on prescriptions must have permits specifying the articles that may be

6. Grinnell, F.: Optical Advertising Remains Deceptive, Bull. Chicago Better Business Bureau **1**:1 (March 26) 1931.

7. Mr. T. E. Obrig informs me that the lenses were not intended for use. They were gathered for Mrs. Terry of Short Hills, N. J., who is doing a great deal of fine work in providing glasses for those unable to purchase them. She buys the lenses and has them inserted in the frames provided by a large number of the public." That the broadcast was subject, however, to misinterpretation is evidenced by the comment made in two successive numbers of the Optical Journal and Review of Optometry (**72**:48 [March 15]; 48 [April 1] 1935).

8. Fitting Glasses by Mail, Report of Bureau of Investigation, J. A. M. A. **85**:286 (July 25) 1925; The Ritholz Frauds, ibid. **105**:64 (July 6) 1935.

9. Post, L. T.: Licensing of Opticians, Am. J. Ophth. **19**:343, 1936.

sold. The state of New York has now under consideration a similar bill. These measures aim to control and possibly eliminate the indiscriminate vending of cheap, inferior lenses.[10]

QUALITY LENSES

The requirements of optical glass are chemical and physical homogeneity, high transparency, freedom from color, durability and definite optical constants. Essential are raw materials of high purity, pots of high thermal and chemical resistance, and melting and annealing furnaces capable of accurate regulation. The iron content of the sand used must be less than 0.02 per cent; otherwise a green or yellowish-green color results. Pure white even-grained sandstone deposits are sought, such as those at Rockwood, Mich., Hancock, Md., and Ottawa, Ill. In crown glass alkali and calcium oxide are essential constituents; in flint glass, lead oxide. With barium incorporated, the dispersive power is lowered and the refractive index raised; with boron, both are lowered. Tables and curves give approximately the chemical composition required to produce the desired optical constants.

Spectacle lenses do not demand the refinement required for the lenses of microscopes, telescopes and spectroscopes or even that for field glasses, camera lenses or lantern slide projectors. The public would not buy annually twenty million cheap tinted blown or dropped goggle glasses if these were not for the most part tolerated by the wearers. Yet a simple test demonstrates how sadly deficient optically such lenses are. When an ordinary blown plano glass is placed in front of a projector the projected image is blurred and distorted, while the same image projected through a properly ground and polished lens appears sharp and clear.

To secure for precision lenses glass that is truly homogeneous—free from all striae of lower refractive index—requires proper stirring methods applied at proper temperatures. Spectacle lenses are not made from stirred optical glass but from plate glass, which is poured from the melting pot on large metal surfaces and rolled into sheets. The striae in the rolling process become parallel to the surface. The ream,

10. The Guild of Prescription Opticians of America, organized in 1926, aims to foster higher standards in dispensing and to eliminate pernicious business practices, such as rebating. The membership is limited to nonrefracting opticians, who sell only at retail, and cater to ophthalmologists exclusively. A member of the guild is pledged to supply only the best in merchandise and service. The present membership is 171 in fifty-six American cities. To exert adequate influence will necessitate at least five times this enrolment. Though there are thirty-eight opticians belonging to this guild in the state of New York (the largest number), there is but one in Illinois! Following a cooperative policy, the guild sends its monthly publication, Guildcraft, gratuitously to all ophthalmologists, and at the annual conventions an address by a prominent ophthalmologist is featured.

as it is called, does not cause serious trouble, since the light generally passes approximately normal thereto.[11] Optical crown glass has now become standardized throughout the world at the refractive index of 1.523 with an allowable variation of 0.001. Plate glass which is cloudy or fails to come within this tolerance is probably used for other purposes.

Rigid inspection must control every stage in manufacture if the final optical lens is to be free from defects. The 500 pound (227 Kg.) sheet of plate glass, 14 by 22 feet (4 by 7 meters), is cut into pieces of the proper weight for molding and inspected. Half the product is rejected because of striae, bubbles, inclusions and crystallites or because of strains due to unequal annealing. The pressing process that follows may produce certain infolding defects ("feathers, folds or laps") and this accounts for another 30 pounds (13.6 Kg.) of loss. Of the ground and polished lenses, 20 per cent are rejected because of an improper thickness, center, surface or focus. After the final edging only 50 pounds (23 Kg.) of perfect lenses are finished from the original batch. However a considerable portion of the rejected glass, called cullet, is used again. The determination of where to draw the line between glass of first quality, that of lower grades and cullet requires experience and discrimination.

After the lenses are pressed into the approximate shape they undergo three processes: (1) rough grinding with coarse corundum, (2) smoothing with emery of two or three successively finer grades and (3) polishing. The polishing of a finely ground glass surface is done on a tool covered with pitch, wax or cloth and coated with moistened polishing material, such as rouge (red iron peroxide), black iron oxide or tin oxide. Dry polishing follows to fill up the sleeks." Polishing with felt, a rapid method, is used for lenses of lower grades, but for lenses of higher grades polishing with pitch is preferred. Whether one always secures a better surface with pitch than with felt is controversial, as much depends on the operators, the equipment and the procedure employed. With either material precision polishing requires slow movements and well lubricated surfaces to prevent heating of the glass. If the polisher runs hot, as is often the case in finishing cheaper spectacle lenses, the exact figure is lost and only low precision results can be obtained. With pitch rouge 80 per cent of the surface is polished in ten minutes, but an hour or more is required to obtain a perfect polish over the entire surface.

11. One of the major optical companies stirs its ophthalmic glass before pouring it on the casting plate, with the hope of effecting thus a considerable loss of striae. Nevertheless a certain amount of ream is inevitably induced by this process since fine striae are caused by only slight differences in refractive index (Wright, F. E.: The Manufacture of Optical Glass, Washington, D. C., Government Printing Office, 1921).

The best quality of glass, the most rigid inspection and the most careful polish are reserved for the so-called corrected lenses, which are the only ones generally maintained at a constantly high standard. One wonders whether the odd base curves of these lenses, varying in some series by 0.12 diopter, were not designed more as a means of ready identification than as a contribution to the corrective efficacy of the lenses. All other lens forms are sold on a competitive basis, the price depending on the grade. One of the great companies that extols its patented lenses to the oculist supplies the department stores with second grade lenses and the dollar store with self-test products.

INSPECTION

Lenses are examined for defects in material, surface and power. In the factory transparency is tested by photometers; minute bubbles, inclusions and "feathers" are observed in dark-ground illumination; and through pinhole illumination striae can be photographed or projected with various devices. Since strained glass exhibits double refraction, this condition is readily detectable by a polarizing apparatus, which is part of the equipment of every good optical shop. Strains result not only from improper annealing but also in fitting lenses to frames and in drilling. Strained lenses are liable to crack at any moment.

The chief surface defects are: (1) chips, scratches and "sleeks," (2) grayness, due to incomplete polishing (the minute roughnesses are discernible in diffuse light), (3) waves, fine ripples or double curvature caused by uneven or unsteady polishing. There are various sources of this error: Wave results when the polishing pad is not correctly curved; in mass grinding at the factories the lenses at the edge of the block tend to be irregular; thin lenses, even if otherwise perfect, when placed in metal frames bend in the center with the consequent creation of wave and cylinder.

Errors in power may arise from variations in the index of refraction or in the thickness of the glass, from the use of unreliable tools, from incorrect calculation of curves or through misinterpretation concerning vertex refraction. Tools become worn with grinding and must be trued periodically. All surface tools are based on an index of 1.530, as are all lens measures. Since crown glass has an index of 1.523, the proper curve corresponding to the prescription must be sought in tables. Moreover, should the prescription be in the equivalent power of symmetrical lenses it must again be accurately converted to the equally effective vertex power of the form prescribed. To accept the finished lenses on faith is hazardous. The lens measure gives only the curves, and those but approximately. But with the instrument variously known as a lensometer, vertometer or rayometer not only can effective power

be rapidly read within 0.03 diopter, but the center and cylinder axis can also be readily and accurately determined. The tolerance of quality lenses is 0.06 diopter, which is about as low as the eye can detect differences.

INFERIOR LENSES

The optical market is flooded with lenses of lower grade since the general public is unable to differentiate between optically correct and incorrect eyeglasses. During manufacture lenses are sorted out because chipped, scratched, off center or off thickness or on account of waves, defects due to pressing or to improper polishing, striae, strains and so forth. The manufacturers dispose of the inferior stock in a confidential and secretive manner. Part goes abroad and part to local jobbers, who dispose of lenses with lesser faults as "seconds" and of those with more defects as "thirds" and "fourths." Certain independent firms specialize in cheap, low-grade lenses produced as the run of the block by methods involving high speed and poor precision with no inspection or rejection.

American second grade lenses sell at two-thirds the price of the first quality product. The cheap labor of Japan permits Japanese lenses of similar grade to be sold at 50 per cent less in spite of a 45 per cent import duty. The Japanese lenses are not made in vertex refraction, do not have the centers dotted, show a poor surface finish and are of a thickness greater than that tolerated by American standards. Cut-rate optical houses purchase them from the import jobbers in huge lots for resale to department stores and advertising firms and for their own prescription work.[12]

The standard gold-filled frame contains one tenth of one-twelfth carat, or 4.5 per cent pure gold. Rose gold has an admixture of copper and nickel; white gold, zinc besides. In the imitation products the gold content is reduced to as little as 0.5 per cent.[13]

12. M. J. Julian (president of the Better Vision Institute) in a personal communication to the author stated: "If the demand for cheaper lenses did not exist, wholesaler and manufacturer would not have the temptation that now exists to supply these inferior grades. There was a time, as you probably know, when manufacturers refused to sell anything but first quality. That policy was broken down largely because of the importations of inferior grades. Incidentally, there is now a very definite trend back toward first quality . . . Unfortunately, there exists the strong, selfish urge to purchase inferior quality at lower prices and then in turn to sell this inferior quality at the usual first quality prices."

13. M. J. Julian in the personal communication cited in footnote 12 stated: "There have been a number of attempts since 1930 to sell frames of substandard metals, but these have brought untold annoyance and injury to the wearer, with the result that they have been almost fully discarded. I believe the public has greatly benefited from the use of gold-filled stock. They save the big difference between gold-filled and solid gold, and at the same time get a frame that for all practical purposes serves almost equally as well."

The tinted globular lenses are produced in two forms with inside base curve of 12 diopters and 6 diopters, called, respectively, coquille and micoquille, i. e., half coquille. These lenses are cut from spherical glass blown to 9 or 18 cm. in diameter and about 2 mm. in thickness. Such lenses are more or less deformed by the unequal contraction that takes place as the globe is cooling. Because of this distortion lenses of this type generally possess undesirable prismatic, cylindric or spherocylindric power. To be considered of good quality the lenses must be ground and polished on tools of appropriate curvature.

There is nothing wrong with low prices themselves. But low quality is something to worry about, and the two are almost invariably associated. Second quality lenses are seldom sold to the consumer as such, because few wearers of spectacles would knowingly accept an inferior product, even at a saving.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

A CONTRIBUTION TO THE CURVILINEAR MEASUREMENT OF THE SCLERA. ANDREA BIFFIS, Ann. di ottal. e clin. ocul. **63:** 1 (Jan.) 1935.

Various methods of measuring the curvature of the cornea and sclera of the anterior segment of the eye are given. Biffis has studied this curvature in about twenty eyes by a photographic method. He has found that the anterior segment of the eye is irregular and that the asymmetry varies from one eye to another. He concludes that the anterior segment is therefore aspheric.

A. PERZIA.

A CONTRIBUTION TO THE KNOWLEDGE OF THE ANATOMY AND CLINICAL SIGNIFICANCE OF THE SEPTUMS AND THE ARTERIES OF THE OPTIC NERVE. C. BEHR, Arch. f. Ophth. **134:** 227 (Sept.) 1935.

In studying the anatomy and physiology of the neuroglia of the optic nerve Behr, an authority in this field, found that the vascular system of the optic nerve had not been investigated sufficiently. He therefore studied ten optic nerves in serial sections, paying special attention to the vascular system and its relation to the sheaths and septums of the nerve.

The ophthalmic artery is not the only artery which supplies the orbit and the optic nerve with blood. There is an anastomosis between the middle meningeal artery and the lacrimal artery. This anastomosis goes through the sphenoid fissure and sometimes becomes the chief artery of the orbit. The central artery of the retina, as soon as it enters the optic nerve, becomes a retinal artery in the strictest sense and no longer carries blood for the optic nerve. The ophthalmoscopic picture of embolism of the central artery can, therefore, be caused by an obstruction of the artery far behind the lamina cribrosa sclerae.

The septums have a mechanical supporting and a nutritive function. At the places where movements of the eye put more strain on the optic nerve the septums are stronger. The most axial part of the intracranial portion of the nerve contains only very few and very thin septums. This fact indicates a poorer nutritional supply to the papillomacular bundle in that region, a fact which explains its great vulnerability.

Three arterial systems which anastomose freely with each other supply the optic nerve: (1) branches of the posterior ciliary arteries, (2) the arteriae nervi optici anteriores, which are branches of the ophthalmic artery and enter the nerve together with the central artery, and (3) the arteriae nervi optici posteriores, which are branches of the major branches of the ophthalmic artery. These arteries as they go through the sheaths of the nerve are surrounded by a system of channels through which the intervaginal space communicates with spaces in the orbital tissue. These channels can actually be seen whenever hemorrhages occur into the intravaginal space. Sometimes the extravasated blood spreads along the arteries into the orbit. The cerebrospinal fluid

can avail itself of these channels, especially if there is increased intracranial pressure. These channels act as a safety valve, a fact which must be considered in any theory concerning the mechanics of a choked disk.

There is no communication between the spaces around the central artery and vein and the intervaginal space.

Many other interesting facts can be found in this paper.

P. C. KRONFELD.

Bacteriology and Serology

BACILLUS PYOCYANEUS INFECTION OF THE EYE. W. W. LANOU, Am. J. Ophth. **18:** 950 (Oct.) 1935.

Lanou gives the following summary:

"1. Two cases of corneal injury followed by a fulminating corneal ulcer and signs of early panophthalmitis are reported.

"2. Bacillus pyocyaneus was identified as the etiologic organism and its pathogenicity for rabbit eyes demonstrated."

W. S. REESE.

EXPERIMENTS WITH EXPLANTATION OF TISSUES OF THE EYE IN VITRO: THE INFLUENCE OF DIPHTHERIA TOXIN ON THE GROWTH OF THE IRIS AND THE CILIARY BODY. P. E. KISIN and L. S. BAZILEVSKAYA, Sovet. vestnik oftal. **7:** 433, 1935.

The purpose of this study was to ascertain the conditions of local immunity uninfluenced by the serum antibodies. The detailed technic of making the cultures, of obtaining the tissues and of preparing the medium and the influence of the diphtheria toxin on the growth of the cultures of the iris and ciliary body are given in this preliminary report. The histologic descriptions of the conjunctiva, sclera, cornea, iris, ciliary body and optic nerve of the rabbit are illustrated by nine photomicrographs; two tables show the growth of cultures with various dilutions of the diphtheria toxin. The experiment with the diphtheria toxin was carried out on the iris and the ciliary body because these gave the best growth and did not liquefy the plasma.

The minimal dilution of diphtheria toxin which completely retarded the growth in all cultures was 1:1,000 (10^{-3}) for the iris and 1:10,000 (10^{-4}) for the ciliary body. There were 807 cultures of the iris, 246 of which were controls, and 622 cultures of the ciliary body with 223 controls. With both the ciliary body and the iris the dilutions of the diphtheria toxin up to 10^{-7} gave retardation of growth in comparison with the control cultures, the degree of the retardation being in direct correlation with the degree of the dilution. The ciliary body proved to be more sensitive than the iris with all dilutions. In both cultures the dilution of 1:10 caused a peculiar differentiation of the growth, as there were, side by side, cultures with an abundant growth and cultures with no growth. This phenomenon could be explained on the basis that the diphtheria toxin in this weak dilution (10^{-7}) stimulated the growth of the more resistant explants and retarded that of the less resistant explants.

O. SITCHEVSKA.

Biochemistry

GLUTATHIONE IN THE BLOOD IN SENILE CATARACT AND OTHER OCULAR CONDITIONS. D. A. CAMPBELL, Brit. J. Ophth. **20:** 33 (Jan.) 1936.

This article is replete with tables and does not lend itself to abstracting. The author's summary of results and his comment are given here.

"There is no marked variation in the reduced glutathione of the blood, with age or diet, or in senile cataract as compared with other ocular conditions. The range for all cases of ocular disease is within the normal.

"In comparison with reduced glutathione, the oxidised glutathione shows considerable variation, especially in non-cataract cases, but no significant change.

"The factor GSH/r.b.c. is not raised above the normal value in ocular disease, and shows the same range in senile cataract as in other ocular conditions, including active keratitis (*cf.*Vele).

"Although these results are negative, it is particularly interesting to find that the blood glutathione, like the blood calcium, remains constant over a certain range in a variety of conditions of age and disease. Moreover, in ocular disease, it appears to be unaffected by the sulfur metabolism of the body, even when there is a large variation in the amount of sulfur which is being ingested. This is probably true also for normal subjects."

W. ZENTMAYER.

THE VITAMIN C CONTENT OF THE AQUEOUS AND LENS IN MAN. B. NAKAMURA and O. NAKAMURA, Arch. f. Ophth. **134:** 197 (Aug.) 1935.

The aqueous of normal human eyes contains 12.8 mg. of vitamin C, or cevitamic acid, per hundred cubic centimeters (Müller and Buschke). To what extent this amount varies with age is not definitely known. In eyes of old persons suffering from senile cataract the authors found the vitamin C content ranging between 2 and 8.6 mg. per hundred cubic centimeters. The nucleus of the cataractous lens contained practically no vitamin C and the cortex very little. In ocular diseases which are likely to lead to complicated cataract the vitamin C content of the aqueous is definitely decreased. "It seems justified to assume close relations between the amount of vitamin C present in the eye and the pathogenesis of cataract."

P. C. KRONFELD.

Blind

SIGNIFICANCE OF SYPHILIS AS A CAUSE OF BLINDNESS. H. MONTLAUR, Arch. d'opht. **52:** 586 (Aug.) 1935.

This study is based on systematic general examination of the blind and has brought out three points having to do with acquired, hereditary and familial syphilis. The conclusions are (1) that hereditary syphilis is infinitely more important than acquired syphilis as a cause of blindness, (2) that sometimes only a careful investigation of the family will reveal the cause of the blindness as familial syphilis, (3)

that the hereditary transmission is more often through the female who has escaped the disease and (4) that prophylaxis of blindness of syphilitic origin lies in the treatment of the pregnant woman.

S. B. MARLOW.

Conjunctiva

EXANTHEMATOUS FORM OF TUBERCULOSIS OF THE CONJUNCTIVA. B. DIMISSIANOS, Arch. d'opht. **52:** 798 (Nov.) 1935.

The patient had lesions of the skin and of the mucous membranes of the mouth and eye that were characterized by the papulonecrotic eruption first described by Barthélemy. Cure followed treatment with tuberculin. Rarely tuberculids have been observed in eyes in the form of lichen scrofulosus or the benign sarcoid of Boeck. The subject is reviewed in connection with the case reported. As the tuberculids may develop without any irritative symptoms, if there is no secondary infection, he suggests that a systematic examination of the mucous membranes of the eye and the mouth should be made in cases of this kind. If this is done it is probable that more cases in which the eyes are involved will be found. The differential diagnosis from other tuberculous conjunctival lesions must be made.

S. B. MARLOW.

A CYSTICERCUS OF THE CONJUNCTIVA. F. CONTINO, Ann. di ottal. e clin. ocul. **63:** 843 (Nov.) 1935.

Contino's patient was a youth of 17 years who had noticed a fleshy growth on the bulbar conjunctiva of the right eye for twenty days. The nodule was 12 by 9 mm. in size and about 6 mm. thick and was located between the insertions of the superior and internal recti. It was painless but adherent to the sclera. An exact diagnosis was not made, but when the growth was removed for diagnostic purposes it was found to contain a dense membrane, out of which escaped a transparent cyst 6 by 4 mm. in size. This was found to be a characteristic larva of Taenia solium. In from one fourth to one ninth of the cases in which a cysticercus has involved the ocular structure it has been reported as involving the conjunctiva. The diagnosis is difficult in the stage when the cyst is surrounded by inflammatory tissue so that the parasite is invisible.

S. R. GIFFORD.

Congenital Anomalies

HISTOPATHOLOGY OF COLOBOMA OF THE CHOROID AND OPTIC-NERVE ENTRANCE. M. L. FOLK, Am. J. Ophth. **17:** 1126 (Dec.) 1934.

Folk reports the case of a woman, aged 46, who stated that she had always had poor vision in her left eye, and who on arrival in this country, had been told that she had a coloboma of the iris. She was now having pain in this eye, and a diagnosis of glaucoma probably secondary to chronic iridocyclitis, coloboma iridis and cataract was made. As conservative treatment failed, the eye was enucleated. The author gives the following conclusions:

"1. A microscopic study of coloboma of the choroid and optic-nerve entrance, probably the first one in the United States, is reported.

"2. The choroid and pigment epithelium were entirely absent in this specimen.

"3. The retina was present throughout, but in a state of malformation.

"4. Neither inflammatory products nor mesodermal strands were found in the region of the coloboma. The presence of doubling of the retina and cyst formation are in support of the ectodermal theory of coloboma formation.

"5. The defect at the nerve entrance was found outside of the nerve sheaths, hence the name coloboma of the optic-nerve entrance."

W. S. REESE.

Cornea and Sclera

MARGINAL DEGENERATION OF THE CORNEA (TERRIEN'S DISEASE). MÁRQUEZ and VELILLA, Arch. d'opht. **52: 707** (Oct.) 1935.

Two new cases are reported, and reports of two cases previously published are reviewed. The first description of this condition was published by Terrien in 1900. The authors therefore suggest that it be called Terrien's disease. The most important characteristics of the disease are discussed systematically under the headings of symmetry, peripheric ectasia, the presence of vessels, hernia of the iris, pterygoid formation, astigmatism, corneal sensation, pathology, pathogenesis, complications and treatment. In their conclusions they agree with Seefelder and Van Duyse that this condition is a special degeneration of the peripheral parts of the superficial layers of the cornea which leads to a thinning of this structure, producing a furrow in its earliest stages and an ectasia in its later ones. Considerable astigmatism results. In addition to causing the visual changes, these alterations are a source of danger to the eye because of the possibility of traumatic or spontaneous rupture with hernia of the iris. As the thinning is partly due to poor nutrition, healing of such wounds is slow, a circumstance of some importance in relation to industrial accidents.

S. B. MARLOW.

MARGINAL DYSTROPHY OF THE CORNEA IN YOUNG SUBJECTS. OPIN and REBOUL, Arch. d'opht. **52: 771** (Nov.) 1935.

Marginal dystrophy of the cornea has been observed only exceptionally in young subjects, the greater majority of the patients having been over 60. A case which occurred in a girl between the ages of 16 and 18 is described, and reports of two other cases are referred to—one in a man of 29, described by Junius, and one in a man of 27, described by Rados. Because of the frequency with which pterygium and pannus are observed in association with this condition and the association of an inflammatory process in the case followed by Rados the authors lean to the opinion that this condition is probably based on inflammation, probably on ulcer. This conclusion, however, should not be too strictly

construed, as it is possible that the clinical picture is not always related to the same pathogenesis. They believe that lipoid infiltration plays a part in the process and that there are other factors as yet unknown.

S. B. MARLOW.

VESICULAR KERATITIS. H. VILLARD, H. VIALLEFONT and SAUVY, Arch. Soc. d. sc. méd. et biol. de Montpellier **16:** 201, 1935.

In a case of bilateral vesicular keratitis of two months' duration, the vesicles one day suddenly disappeared. Corneal anesthesia, hyperemia and blepharospasm, however, continued. In this patient the manifestation appears to have been connected with the posterior cervical sympathetic syndrome previously described by Viallefont.

J. E. LEBENSOHN.

"DEGENERATIO CORNEAE SPHAERULARIS ELAIOIDES." L. LUGLI, Arch. f. Ophth. **134:** 211 (Sept.) 1935.

Lugli describes a type of corneal degeneration in old persons which is characterized by subepithelial opacities in the limbic region (*sphaerularis elaioides*) having the appearance of droplets of oil. The opacities appear yellow in direct light and more brownish and transparent in indirect light. They first occupy the nasal and temporal limbus of each eye and then spread upward and downward and finally toward the center of the cornea. If the condition is extensive the vision is somewhat disturbed. The whole process is purely degenerative and slowly progressive. In three cases pieces of cornea became available for pathologic examination. Bowman's membrane was found to be transformed into a fibrillar tissue. The "oil droplet" granules lay in front of, in and behind the fibrillar tissue. Lugli believes that they are a variety of hyalin.

P. C. KRONFELD.

General Diseases

THE QUESTION OF OCULAR FOCAL INFECTION. W. KAPUSCINSKI, Ann. d'ocul. **172:** 817 (Oct.) 1935.

In spite of numerous publications on this subject, there still exists a wide difference of opinion. Kapuscinski does not attempt to review the literature but refers to two recent publications by Zanettin in Italy and Hessberg in Germany.

For a better understanding of the condition he thinks it is necessary to examine thoroughly the primary inflammatory focus. Tuberculosis is considered by the German school as the most common cause of inflammation in the eye, particularly that in the uvea. Even if this opinion is correct, it is necessary to see whether the tuberculous alterations are not often metastatic from a distant tuberculous focus. Most ophthalmologists who speak of focal infections of the eye do not think of tuberculosis but of some far removed inflammatory focus in the tonsils, prostate, pharynx, sinuses and teeth.

It is with regard to the importance of the dental focus that opinions are most divided. The original focus in most of the cases studied was dental. There was only one case, one of iridocyclitis in a patient of 23

years, in which appendicitis was put forward as the cause. This diagnosis was verified by the surgeon, and two weeks after the operation the precipitate had disappeared from Descemet's membrane. In fifty-one cases of unilateral iritis and iridocyclitis, roentgenograms of the teeth and a Wassermann test and a tuberculin test were made. In eleven of the cases bad teeth were the undeniable cause, the inflammation disappearing in from five to eight days after extraction of the teeth.

S. H. McKee.

Amaurosis Due to Loss of Blood. S. F. Karzhenyants, Sovet. vestnik oftal. **7:** 391, 1935.

A woman aged 42 became totally blind one week after repeated vomiting of blood (about 2 quarts [946 cc.]). The pupils were dilated, the optic disk was pale, the retinal vessels narrow, and the color of the fundus yellowish. The blood picture was that of severe anemia. Blood transfusions did not restore the vision during a period of observation extending over nine weeks.

O. Sitchevska.

General Pathology

Pathologic Examination of the Brain in a Case of Monolateral Peripheral Blindness and in a Case of Chronic Alcoholic Retrobulbar Neuritis. A. Juba, Klin. Monatsbl. f. Augenh. **95:** 148 (Aug.) 1935.

Juba reports two cases of ocular disturbances in which he made a histologic and a pathologic examination of the brain. These examinations presented valuable information regarding the structure and the projection of the peripheral optic neurons.

1. A man aged 34 had chronic alcoholic retrobulbar neuritis coupled with delirium tremens, polyneuritis and pulmonary tuberculosis. The degeneration of the papillomacular bundle could be traced in the intracranial portion of the optic nerve, the chiasm and the optic tract. In the external geniculate body a dorsocentral area of atrophy was found. The atrophy had developed as a result of the degeneration of the papillomacular fibers; it indicated the area of projection of the central vision in the external geniculate body. Fine and well defined fatty degeneration was found in a symmetrical arrangement in the optic radiation of Gratiolet. This degeneration was affiliated with the atrophy in the geniculate body.

2. A man aged 48 died of taboparalysis, bronchopneumonia and heart failure. Monolateral peripheral blindness had existed since enucleation of the right eye. Alternating atrophy of the lamellae was present in both external geniculate bodies. It was noted that the central layers of the large and medium-sized cells were atrophic on the side of the optic atrophy, and the peripheral ones, on the opposite side. This condition corroborated earlier observations of Minkowski, who contended that the crossing nerve fibers terminate in the peripheral lamellae and the noncrossing ones in the central lamellae. The healthy condition of the gray pregeniculate substance supported Hechst's contention that this body does not belong to the genuine primary optic centers. The optic cortex was perfectly intact.

K. L. Stoll.

Injuries

OCULAR CHALCOSIS. R. VON DER HEYDT, Am. J. Ophth. **18:** 1045 (Nov.) 1935.

Von der Hoydt discusses ocular chalcosis, or impregnation of the tissues of the eye with copper. He describes its distribution in the cornea, lens and vitreous, and reports the case of a girl whose eye had been penetrated by a piece of copper wire.

W. S. REESE.

OCULAR INJURIES IN CHILDREN. M. G. RABINOVICH and M. K. KULIEVA, Sovet. vestnik oftal. **7:** 188, 1935.

This is a study of 194 ocular injuries in 152 boys and 42 girls up to 14 years of age treated in the Baku Central Eye Hospital during the years from 1932 to 1935. Four tables show the incidence of such traumas in children and in adults, the periods of hospitalization, the objects producing the injuries, the degrees of infection and the results as to vision. The most serious injuries were penetrating wounds of the eye, which occurred in 124, or 63.8 per cent, of the children. The most frequent complications were prolapse of the iris, which occurred in 52, or 41.9 per cent, and traumatic cataract, which occurred in 44, or 35.5 per cent. In 27 of the cases the eyes had to be enucleated or eviscerated. Intra-ocular foreign bodies proved to be the most dangerous, as 7, or 58.3 per cent, of 12 eyes containing foreign bodies had to be enucleated; 12 eyes were lost functionally, as the vision was nil, though the eyeball remained as a cosmetic result.

Sympathetic ophthalmia was not encountered, as conjunctival flaps were always applied to fresh wounds after the method of Kuhnt to prevent infection, and eyes showing irritation for more than two weeks were enucleated.

In view of the high incidence of loss of the affected eye (in 41, or 21.1 per cent, of the cases) despite the prophylactic measures Rabinovich urges that (1) parents be instructed to prevent their children from using instruments and playthings of a type leading to injuries of the eyes, and that (2) the selling of toy pistols be absolutely prohibited.

O. SITCHEVSKA.

Lens

ARACHNODACTYLY AND BILATERAL ECTOPIA LENTIS. G. MORARD, Arch. d'opht. **52:** 344 (May) 1935.

Reference is made to the more complete studies of cases of arachnodactyly which have recently appeared in the literature. The case of a boy 10 years old is described in detail. No other members of the family were affected. The cases which have been reported since the complete study by Viallefont and Temple are listed, 22 in number, 19 with ectopia lentis. Altogether 125 cases have been collected, 62 with ectopia lentis. Morard cites the opinion of Mann that this condition is more likely due to a genetic defect than to endocrine or chemical changes.

S. B. MARLOW.

AN ABSCESS OF THE LENS. YVER and BARRAT, Arch. d'opht. **52:** 676 (Sept.) 1935.

Abscess of the lens is very rare and is most often caused by a foreign body in the lens. The authors report their observations in a case in which an abscess of this type followed a penetrating wound. There were two stages in its development. For sixteen days after the injury conditions gradually improved, and up to the end of this time the lens, at least the pupillary portion, remained clear. Then, suddenly, acute inflammation developed with formation of an abscess necessitating evisceration. Generalized cataractous changes were not observed, as is most commonly the case, the lens remaining clear up to the time of the development of the abscess. The organism recovered was a staphylococcus.

S. B. MARLOW.

OPERATION FOR CHOROIDAL CATARACT. ANTONIO J. MANES, Arch. de oftal. de Buenos Aires **10:** 671 (Sept.-Oct.) 1935.

Referring to former bad results obtained by older methods of operation for choroidal cataract, Manes stresses the relatively satisfactory results with the intracapsular method, in which he avoids iridectomy, separating the possibly existing synechiae with a spatula and effecting the extraction by means of the forceps.

In dealing with calcareous cataract, in which this is not feasible, he tears the anterior capsule with Elschnig's toothed forceps and terminates the operation extracapsularly.

As a rule, a satisfactory projection of light is convenient; the tension should be more or less normal, and the operation should be performed when there is no inflammatory reaction. The prognosis depends on the cause and on the condition of the eye.

In operating for cataract complicating retinal detachment the possibilities depend on the condition of the eye and on the perception of light. When the vitreous is very fluid this may flow out of the eye when the corneal section is made; an extensive iridectomy and extraction with the loop are indicated.

C. E. FINLAY.

WHICH IS THE MOST OPPORTUNE MOMENT FOR EXTRACTING CATARACT? H. ARRUGA, Arch. de oftal. hispano-am. **35:** 626 (Dec.) 1935.

Arruga considers waiting for the maturation of a cataract before operating an error. As a general rule the cataract should be extracted as soon as sight is so reduced as to hinder the reading of ordinary newspaper type. He studies the question in relation to different kinds of cataract. In the case of senile cataract, as regards the intracapsular operation, the preferable time is when vision is reduced to from 2/10 to 3/10, but operation can be undertaken at any time before intumescence, also after maturation. In the case of hypermature cataract, extraction in toto is possible but not easy. The extracapsular operation is best done when vision is reduced to from 1/10 to 3/10 to counting of fingers at 0.5 meter, but the cataract can be removed by this method at any later time. When both eyes are affected one

should wait for reduction of vision in the better-seeing eye. Complicated cataracts must be dealt with according to the individual circumstances. In treating traumatic cataracts one must be guided by the local conditions. In the case of luxated cataract, extraction by diathermic puncture (Lacarrère) is the operation of choice. Congenital and zonular cataracts should preferably be dealt with when the patients are between 4 and 6 years of age, when schooling is unaffected.

C. E. FINLAY.

THE FORMATION OF VITAMIN C IN THE LENS. H. K. MÜLLER, Arch. f. Augenh. **109:** 434, 1935.

In a previous article Müller showed that lenses incubated in aqueous under appropriate conditions show an increase in their ability to reduce indophenol and therefore apparently an increase in their vitamin C. Since it is possible that the increase in the vitamin C in the lenses under these conditions came from the aqueous he ran a series of experiments in which the lenses were incubated in Ringer-Locke solution. For this purpose he divided the lenses used into two groups, i. e., lenses weighing 2.5 Gm. or under from young oxen, and lenses weighing over 2.5 Gm. from old oxen. This method of determining the approximate age of the lenses he considers more accurate than taking the opinion of the slaughter-house on the age of the animals.

In 25 of the 28 young lenses he showed an increase in the vitamin C. In the older lenses, on the other hand, there was no definite increase in the vitamin C. The normal vitamin C content is judged in each case by comparison with the vitamin C content in the fellow eye.

A second series of experiments showed that in the young lenses there was considerable loss of sugar under these conditions, while this could not be demonstrated in the older lenses.

In a third series he determined the glutathione of the lenses and found that in the young lenses there was an increase in reduced glutathione, whereas in the older lenses there was a slight decrease.

From these experiments he draws the conclusion that vitamin C arises in the lens from sugar by the delivery of hydrogen in oxidized glutathione.

F. H. ADLER.

Lids

A TICK ON THE UPPER EYE-LID (DERMACENTOR AURATUS NYMPH). E. O. G. KIRWAN, Brit. J. Ophth. **19:** 659 (Dec.) 1935.

A Mohammedan, aged 22 years, was bitten by an insect while he was playing with a dog. Two weeks later a small growth appeared, which increased in size. A small tick was found attached to the inner end of the lower border of the left upper eyelid. Microscopic examination showed that it was a nymphal form of Dermacentor auratus. This species has been recorded a few times as being found on man in India but usually lives on wild animals.

The article is illustrated.

W. ZENTMAYER.

THE TREATMENT AND COMPLICATIONS OF CHALAZIA. A. H. BRIGGS, Brit. J. Ophth. **20:** 68 (Feb.) 1936.

Briggs discusses the common complications and the pathology of the chalazion. He considers what he terms the "customary operations of incision and curettage" not sufficient to effect a satisfactory permanent cure in long-standing or complicated cases. The procedure of dissection and removal under procaine hydrochloride infiltration anesthesia is to be preferred.

The appropriate treatment of the various complications is also discussed.

W. ZENTMAYER.

Methods of Examination

SQUINT MEASUREMENT WITH PRIESTLEY SMITH'S IMPROVED METHOD. M. E. ALVARO, Am. J. Ophth. **18:** 143 (Feb.) 1935.

A method is described which has as its basis the Holzer modification. Two rigid arms are used, between which is the measuring tape, kept taut by a plumb weight. A table of corrections is given.

W. S. REESE.

RED MULTIPLE MADDOX ROD WITH A PRISM. C. BERENS, Brit. J. Ophth. **19:** 661 (Dec.) 1935.

Berens has incorporated a prism of known strength with the red multiple Maddox rod, using a 0.75Δ prism with the base at right angles to the rod image. A short handle in line with the streak image and attached to the frame facilitates rapid rotation of the device and reversal of the position of the base of the prism. For a person with no vertical imbalance a quick rotation of the prism will cause the line to appear alternately above and below the light, approximately at equal distances. With the rod held before the right eye, the prism base up, if the streak bisects the light there is left hyperphoria of 0.75Δ.

The test is well adapted for use in the examination of applicants for the Air Service of the Army and Navy because negligible amounts of heterophoria may be quickly and easily eliminated.

W. ZENTMAYER.

Ocular Muscles

FATIGUE OF CONVERGENCE INDUCED BY READING AS A FUNCTION OF ILLUMINATION INTENSITY. M. LUCKIESH and F. K. MOSS, Am. J. Ophth. **18:** 319 (April) 1935.

The authors describe a convergence ergograph and conclude from their experiments that muscular fatigue from reading indicated by changes in tonicity of the internal rectus muscles is approximately three times as severe under 1 foot-candle of illumination as under 100 foot-candles, and that the subjects read nearly 10 per cent faster under the latter amount of illumination. They conclude that at least 100 foot-candles of illumination is necessary for reading under usual conditions.

W. S. REESE.

TREATMENT OF SQUINT AMBLYOPIA AND ITS RESULTS. A. GARCÍA MIRANDA, Arch. de oftal. hispano-am. **35:** 393 (Aug.) 1935.

After a review of older opinions for and against production of amblyopia ex anopsia in cases of squint and the success of different ophthalmologists in improving the vision of the amblyopic squinting eye by exclusion, for varying lengths of time, of the good-sighted fixing eye, the author makes special mention of Sattler's procedure by means of a thick black cloth applied over a layer of gauze to the closed eye and fixed to the orbital margin by mastisol (a benzene solution of resins). He employed this is in a series of thirty-two cases from Schieck's clinic at the University of Wurzburg, Germany. The cases comprised two groups:

1. Twenty-one cases in which, after a careful correction of refractive errors, occlusion with a mastisol bandage was followed by stereoscopic exercises (Bielschowsky). In one instance an improvement of the amblyopia was obtained.

2. Eleven cases in which refractive correction a year before had produced no results and the patients had been submitted to operative procedures. Most of the patients were older children with a high degree of squint and considerable amblyopia. In this group the bandage was applied and the exercises commenced only after an operative procedure.

In the majority of cases the squint dated from the first to the third year of age. There were twenty-five cases of convergent squint, four of alternating squint, three of divergent squint and four of amblyopia without squint. The ages of the patients treated were relatively high, between 10 and 12 as a mean in those over 10, and between 7½ and 8 in those under 10. The vision ranged from 1/60 to 1/35, being under 1/10 in one-third. The squint angle in group 1 was 5° in a third of the cases, between 5° and 10° in another third and between 10° and 20° in the remaining third; in group 2, it ranged between 20° and 30°. No relation between the squint angle and the amblyopia was noted. Eccentric fixation was found in four cases of group 2.

In group 1, the visual result obtained in children under 10 was eight times the original vision; in those over 10, only three to four times. In group 2, in children under 10, the visual improvement obtained was twenty-one times the original; in those over 10, fourteen times.

In group 1, the optical correction produced a reduction of the squint angle in all cases and its disappearance in one-fourth. In group 2, the correction ranged from 0° to 8°. In group 1, binocular vision with perception of depth was obtained in one half of the cases in children under 10 and in four or five cases in those over 10. In group 2, binocular vision was obtained in three fourths of the cases. The duration of the stereoscopic exercises ranged between three and six months.

In no cases were prisms used; where no improvement in squint angle was obtained after treatment, operative measures were resorted to.

The central scotomas to which Uhthoff called attention were not noted in any of the cases.

C. E. FINLAY.

Operations

ADVANCEMENT OF THE SUPERIOR OBLIQUE AND INFERIOR OBLIQUE OCULAR MUSCLES. J. M. WHEELER, Am. J. Ophth. **18:** 1 (Jan.) 1935.

To shorten the superior oblique muscle Wheeler opens the conjunctiva in the upper fornix, exposing the superior rectus muscle, the eye being turned well down by a suture attached to the sclera just above the cornea. A suture is passed through the superior rectus muscle near its insertion, and the tendon is cut and allowed to retract. A squint hook is slipped under the superior oblique muscle, and a double-needle suture is passed through the middle third of the tendon several millimeters from its insertion. The two needles are then inserted in the sclera beyond the insertion so that when tied a tuck results. The effect can be regulated according to where the scleral stitches are placed. Thus, if a torsion effect is desired, the scleral stitches, or new insertion, should be farther forward. An operation for shortening the inferior oblique muscle is also described.

W. S. REESE.

CORNEAL GRAFTING (KERATOPLASTY): SOME MODIFICATIONS IN TECHNIC. H. B. STALLARD, Brit. M. J. **1:** 106 (Jan. 18) 1936.

Stallard has found the following modifications of the technic of corneal grafting to be helpful.

The essential in cutting a corneal graft is to bevel the deeper parts of its substantia propria and that of its bed so that the graft will not slip from the bed into the anterior chamber. After reviewing the methods which are now practiced to overcome this difficulty, he suggests that less damage would be caused if a series of cuts less than 1 mm. long and set side by side at a slight angle were made by sweeping a small angular knife obliquely through the deeper half of the cornea around the circumference of the graft.

He follows Rycroft's procedure in employing a complete conjunctival flap drawn over the entire cornea and its graft and retained in place by a purse-string suture. To immobilize the eye during operation, as the eye is apt to make roving movements, two no. 1 white silk suture threads are passed through the superficial layers of the sclera at about 1.5 mm. from the limbus at 12 and 6 o'clock. These threads are held by an assistant and maintain the position of the globe during the operation.

The operation is then described and pictured in detail, together with the preoperative preparation and postoperative treatment. The article should be read in the original.

A. KNAPP.

A SIMPLE AND SURE OPERATIVE PROCEDURE FOR DACRYOCYSTORHINOSTOMY. L. WEEKERS, Arch. d'opht. **52:** 241 (April) 1935.

Weekers is of the opinion that failure to obtain a good result in dacryocystorhinostomy is almost always due to closure of the opening made in the wall of the lacrimal sac. It is possible to avoid this by separating the sides of the incision and keeping them apart during the healing. In the operation which he describes this is accomplished by passing sutures through the anterior edge of the incision in the sac itself

and carrying them beneath the skin on the side of the nose anterior to the incision in the skin. The procedure is simple to carry out. It is illustrated by diagrams.

S. B. MARLOW.

Orbit, Eyeball and Accessory Sinuses

XANTHOMATOSIS OF THE ORBIT (LIPOGRANULOMA). R. M. ROGERS, Am. J. Ophth. **17**: 1141 (Dec.) 1934.

After a brief review of the literature, Rogers reports the case of a woman, aged 37, who four years prior to examination noticed a yellowish discoloration of the skin of the right upper eyelid. This yellow tinge became deeper, and a like discoloration gradually developed in the other eyelid. The lids then became thickened, and the globes began to protrude. Five months prior to examination the patient gave birth to a normal child. During the course of the pregnancy polyuria and polydipsia developed.

Examination revealed a golden-yellow staining of the lids, which were double the normal thickness. The eyes were proptosed, the right measuring 37 mm. and the left 25 mm. Both eyes showed papilledema. The right cornea presented an ulcer due to exposure, and the vision of this eye was eventually lost, the patient having refused tarsorrhaphy. The vision of the left eye failed gradually as the papilledema and proptosis increased. The author gives the following summary: "The case presented is of the primary type of lipogranuloma, with deposits in the orbital tissue and eyelids, the diagnosis from biopsy specimen being one of the few reported to date. The roentgen findings were negative for changes in the skull and long bones except those noted in the sella turcica. That diabetes insipidus is due to pressure at the base of the brain involving the third ventricle (tuber cinereum and infundibulum), or possibly the posterior lobe of the hypophysis, is the usually accepted explanation, and that there was disturbance in this area in this case may be accepted from the x-ray findings and the growth of new hair. The only abnormal finding in the blood examination was the increase of cholesterin which accounts for the deposition of lipoids."

W. S. REESE.

UNILATERAL EXOPHTHALMOS DUE TO PRESSURE ON THE CERVICAL SYMPATHETIC NERVE IN THE NECK. R. CAZALIS and J. DUGUET, Arch. d'opht. **52**: 440 (June) 1935.

Cazalis and Duguet present the case of a young woman, aged 27, who had had unilateral exophthalmos since childhood, as shown by photographs. Both eyes were normal except that the retinal veins of the left eye were slightly dilated. The exophthalmos was known to have increased at times after hard work. The increase developed in a day or two and disappeared in from five to seven days. There had been no periods of increase after her marriage, when her work became lighter. At the time she was observed there was an increase of the proptosis accompanied by retrobulbar hemorrhage. She was about to menstruate and had done some hard work at home two days before. At this time the exophthalmos, which had previously been reducible by pressure, was no

longer reducible. There was no pulsation, vascular bruit or pain. There was no diplopia, the movement of the eye being normal. There were no general symptoms except slowness of pulse, severe nausea and epigastric distress. The next day conditions became aggravated; the eye was fixed in the orbit, the lids ecchymotic, the conjunctiva chemotic. On exploratory puncture 2 cc. of bloody fluid was removed. This did not coagulate. Improvement followed. A roentgenogram of the neck disclosed that the left transverse process of the seventh cervical vertebra was much larger than the right. The authors believe that this produced pressure on the cervical sympathetic nerve and that it accounts for the exophthalmos. The dilatation of the retinal vessels can be explained by it; the slowing of the pulse was an oculocardiac reflex. The explanation of the orbital hemorrhage is more difficult, though the condition is probably related to the menstrual cycle. In 1923 Crouzon found Horner's syndrome in only two of fifty-six cases of changes in the seventh cervical vertebra. No case of excitation has been described.

S. B. MARLOW.

LUXATION OF THE EYEBALL BY AN ORBITAL OSTEOMA. M. SORIA, Arch. de oftal. hispano-am. **35:** 195 (April) 1935.

Soria reports a case of exophthalmos produced by an osteoma of the superior and external walls of the orbit, with no lesions of the fundus and with preservation of perfect sight and motility of the eye, in which eyelids could close behind the globe. A roentgen examination revealed an opacity at the site of the growth. The tumor was removed with chisel and hammer by the Krönlein method. There followed correction of the exophthalmos, and sight was preserved. The optic nerve showed no lesion, notwithstanding the great stretching to which it had been subjected. A histologic examination of the growth showed normal composition of bone.

C. E. FINLAY.

Pharmacology

ACTION ON THE EYE OF A NEW PHYSOSTIGMINE-LIKE DRUG (DI-METHYLCARBAMIC ESTER OF 3-OXYPHENYL-TRI-METHYLAMMONIUM METHYLSULFATE). G. ROSSI, Arch. di ottal. **42:**341 (Sept.-Oct.) 1935.

The drug is a parasympathetic stimulant investigated by White and Stedman among other drugs in which the urethane group, to which physostigmine owes its activity, was combined with various other radicals. This drug is the di-methylcarbamic ester of 3-oxyphenyl-trimethylammonium methylsulfate. It stimulates both smooth and striped muscle, the action being not on the muscle fiber, as with physostigmine, but on the neuromuscular connections. In general effect it is less toxic than physostigmine.

Rossi employed a 1:2,000 and a 0.5 per cent solution. The weaker solution produced miosis in the enucleated frog's eye of about the same degree as that produced by a 1 per cent solution of pilocarpine and a 0.5 per cent solution of physostigmine. On the living rabbit's eye the 1:2,000 solution was more effective than similar solutions of physostig-

mine and pilocarpine, while a 0.5 per cent solution was about equal to a 0.5 per cent solution of physostigmine and superior to a 0.5 per cent solution of pilocarpine. On the epinephrinized pupil physostigmine was slightly more effective. A 0.5 per cent solution partially counteracted the effect of atropine. The effect on intraocular tension was about the same as that of physostigmine. No toxic symptoms were produced by repeated instillations of the drug, and on subcutaneous injection it proved to be about half as toxic as physostigmine.

In the normal human eye five drops of a 1 : 2,000 solution produced miosis and a fall in tension of 5 mm. after two hours. In two patients with glaucoma the effects on the pupils and tension of a 1 : 2,000 solution were about the same as those of physostigmine. Solutions of the di-methylcarbamic ester of 3-oxyphenyl-tri-methylammonium methylsulfate are more stable than those of physostigmine.

S. R. GIFFORD.

The Pupil

THE ARGYLL ROBERTSON SIGN IN NONSYPHILITIC DISEASES. C. DUC, Ann. di ottal. e clin. ocul. **63:** 855 (Nov.) 1935.

Duc examined the pupillary reactions in 1,200 inmates of a hospital for psychopathic patients. He found five inmates in whom the Argyll Robertson pupil was present without any other evidence of syphilis. The first was a woman of 56 years with a psychoneurosis. Her pupils were irregular, the left being smaller than the right. A trace of reaction to light was demonstrated in the right eye, but there was none in the left, while the reaction in accommodation and convergence was normal. The condition remained the same during eight months' observation, and the Wassermann tests on the blood and spinal fluid were negative. The second was a patient who had paranoia with unilateral absence of the reaction to light and miosis, while accommodation was preserved. The Wassermann test of the spinal fluid was negative, and there was no other sign of organic disease of the central nervous system. The third patient had dementia praecox with a negative Wassermann reaction; no examination of the spinal fluid was reported. The fourth was one who had senile psychosis with complete loss of the reaction to light on one side and almost complete loss on the other, both pupils being in miosis; the Wassermann tests of the blood and the spinal fluid were negative. The fifth had paranoia with complete loss of the reaction to light on one side and partial loss on the other, and the blood gave a negative Wassermann reaction. Duc admits the difficulty of excluding syphilis in these patients and found no other organic disease of the central nervous system which would account for the Argyll Robertson sign.

S. R. GIFFORD.

Physiology

RECURRENT VISION WITH A MOVING STIMULUS OF ALTERNATING INTENSITY. F. L. WARBURTON, Brit. J. Ophth. **19:** 672 (Dec.) 1935.

Warburton describes the device used in this experimental study. He concludes: "All the phenomena observed receive a satisfactory explanation on the basis of the general form of the hypothesis usually

adopted to account for the phenomena observed when a moving stimulus of constant intensity travels across the retina. They thus support the hypothesis that these phenomena are largely due to the temporal course of the sensation produced by a stimulus of short duration, although spatial induction may inhibit some part of the course of sensation. This latter fact would appear to act with alternating intensity, and so to be due to the whole of the bright part of sensation, and not merely to that in parts of the retina immediately adjacent to that where inhibition took place."

W. ZENTMAYER.

THE RESPIRATION OF THE OPTIC NERVE. D. MICHAIL and G. BENETATO, Compt. rend. Soc. de biol. **121:** 267, 1936.

Optic nerves obtained from twelve human eyes were sectioned immediately after enucleation of the eyes into segments 0.5 mm. thick, and the consumption of oxygen was determined by the Warburg method. In eyeballs removed because of trauma the average hourly consumption of the presumably normal nerve was 114 cu. mm. per gram; in glaucomatous eyes there was an increase to 172 cu. mm.; in eyes with optic atrophy, to 197 cu. mm. This increase resulted from the respiration of actively proliferating glial tissue or, possibly, from the irritation of the nerve elements, since experimental trituration of nerve tissue doubles its oxygen consumption.

J. E. LEBENSOHN.

Refraction and Accommodation

LENS EXTRACTION IN MYOPIA. A. ELSCHNIG, Am. J. Ophth. **17:** 1118 (Dec.) 1934.

Elschnig has performed 110 lens extractions for myopia. Twelve of the patients were over 23 years of age. The younger ones were operated on by discission and linear extraction, and the older ones by intracapsular extraction with incision of the root of the iris. The results were very satisfactory. He advises against operation on younger patients in whom the myopia is less than 18 diopters and stationary, but he operates on those with myopia of 14 diopters if the condition is progressive. He also operates when the correcting lenses do not give satisfactory vision. He does not operate on an eye if the fellow eye has a detachment, yet does not believe that the operation increases the danger of the detachment.

W. S. REESE.

INTENSITY OF LIGHT IN RELATION TO THE NEAR POINT AND THE APPARENT RANGE OF ACCOMMODATION. C. E. FERREE and G. RAND, Am. J. Ophth. **18:** 307 (April) 1935.

Ferree and Rand cite as beneficial effects of increased intensity of light: increased visibility, decreased ocular discomfort, increased range of vision, increased tolerance for defective coordination of accommodation and convergence, increased tolerance of any refractive defect and increase in definition due to miosis. They conclude from their experiments that the presbyopic eye is greatly benefited by increased illumination and that this should be kept in mind as an aid to presbyopia.

W. S. REESE.

ANISEIKONIA: SOME CLINICAL OBSERVATIONS. W. L. HUGHES, Am. J. Ophth. **18:** 607 (July) 1935.

Hughes defines aniseikonia, explains its management, and reports illustrative cases. He estimates that 30 per cent of persons wearing glasses have a measurable amount, and he enumerates the symptoms. He suggests that it may be the cause of defective fusion in some cases.

W. S. REESE.

Retina and Optic Nerve

STUDIES OF THE RETINAL CIRCULATION BY DIRECT MICROSCOPY. R. K. LAMBERT, Am. J. Ophth. **18:** 1003 (Nov.) 1935.

Lambert records the following conclusions:

"1. Photomicrographs have been taken of the fundi of living experimental animals and certain vessel responses studied.

"2. In the higher forms, the intravenous administration of adrenalin usually produced widening of the vessels, whereas nitroglycerine and amyl nitrite produced narrowing.

"3. In the higher forms, no measurable response could be elicited by stimulation of the cervical-sympathetic nerve.

"4. Reasons are given for believing that the type of responses encountered depends upon the histological characteristics of the retinal vasculature."

W. S. REESE.

FUNCTIONAL EXAMINATION OF PATIENTS OPERATED ON FOR RETINAL DETACHMENT AND CONSIDERED CURED. P. DESVIGNES, Ann. d'ocul. **172:** 976 (Dec.) 1935.

The retina has three functions: perception of light, of color and of form. Each of these functions differs in the peripheral and the macular area. For a complete study of retinal functions it would be necessary to study each of these functions in these two areas, but such a study presents numerous difficulties. In particular, no apparatus at one's disposal permits exact measurement of the minimum of light perceptible or of the differential minimum.

In studying retinal adaptation to darkness, Desvignes has employed the skotoptikometer of C. Edmund. He gives his method in detail and the results of seven observations. He found (1) that adaptation to darkness was much diminished in all cases, (2) that the visual peripheral field for white was nearly normal in the cases in which there were no chorioretinal cicatrices and (3) that the visual clearness was low in four of the seven cases.

S. H. MCKEE.

SPASM OF THE RETINAL ARTERIES. P. BAILLIART and A. ROLLIN, Bull. Soc. d'opht. de Paris, October 1935, p. 612.

Bailliart and Rollin report the case of a patient aged 59, in whose left eye temporary loss of vision had occurred at short intervals for from two to three years. The attacks lasted for from fifteen to thirty seconds, with instantaneous return of vision. The pupils and the ocular tension

were normal. The left disk was paler than the right. In all the arterioles of the left eye areas of attenuation at intervals were noted. The retinal arterial tension was over 100 mm. for the left eye and only 55 mm. for the right. The left retina presented a whitish-gray edema encircling the macular area. In the right eye spasms of the inferior temporal artery were noted. Otherwise this fundus showed no changes. The vision of each eye was 10/10. The left visual field was contracted to within 10° of the point of fixation. The peripheral portion of the field of the right eye was normal. The color sense of each eye was normal. General physical examination disclosed no abnormality and especially no arterial change. At times the patient complained of a temporary loss of hearing. A series of twenty injections of acetylcholine was given, with some relief from the symptoms but no change in the field of vision. The unusualness of the symptoms and findings justify the presentation.

L. L. MAYER.

RETINITIS PIGMENTOSA AND AVITAMINOSIS. F. CASINI, Arch. di ottal. **42:** 409 (Nov.) 1935.

Retinitis pigmentosa was seen with polydactylism in a man of 40. The association of these conditions is part of the Laurence-Moon-Biedl syndrome. The blood cholesterol was found to be much reduced and was brought to normal by the use of a vitamin A concentrate and by general ultraviolet irradiation. Although the central vision, which was reduced to the point of counting fingers, did not change, there was some improvement in the visual fields. Two brothers were seen who had retinitis pigmentosa and meningocele. One of these patients had well developed xeroderma pigmentosum. The relation of blood lipoids and vitamin A to the preservation of the visual cells is discussed, also that of vitamin C to the formation of melanin. In one of these cases large doses of cevitamic acid were given, with no effect on the vision or the visual fields.

S. R. GIFFORD.

SCLERAL TRANSILLUMINATION IN LOCALIZATION OF RETINAL TEARS. J. L. PAVIA, Arch. de oftal de Buenos Aires **10:** 598 (Aug.) 1935.

After reference to von Manen's periscopic transilluminator of the sclera for the localization of retinal tears, Pavia describes his method of transillumination by means of a Lange lamp applied to the scleral surface and observed through a contact glass, the retinal tear lighting up when the application coincides with it. He has used this method with satisfactory results in several cases.

C. E. FINLAY.

ABLATIO FALCIFORMIS CONGENITA. H. WEVE, Arch. f. Augenh. **109:** 371, 1935.

Weve reports seven cases of a congenital defect of the retina which he terms "ablatio falciformis congenita." The anomaly varies in appearance from that of a sector-shaped detachment of the retina to that of a pseudoglioma. In the majority of the cases the retina shows a duplication stretched out like a sail between the papilla and the region between

the lens and the ciliary body. In the cases reported the fold was in the lower temporal quadrant.

In one of the cases in which the eye was examined histologically the fold was caused by a skein of connective tissue in the anterior portion of the vitreous. This skein was more or less connected with the lens and with the surface of the retina, which was proliferated at this point.

No inflammatory signs were present which differentiated this condition from that caused by cyclitic membranes, nor were there any evidences that trauma had played a part. The finding of a persistent pupillary membrane in the same sector, as well as the familial occurrence and the predilection for a certain section of the retina, places this in the category of a congenital defect due to some unknown disturbance in development.

In the connective tissue a considerable amount of hematogenous pigment was found, which suggests the possibility that hemorrhages in the membrana vasculosa lentis or in the primary vitreous may have played a rôle.

In all the cases in which the condition was bilateral the vision was exceedingly poor and nystagmus was present.

The article is excellently illustrated with drawings of the fundi.

F. H. ADLER.

PERIPHLEBITIS AND ENDOPHLEBITIS OBLITERANS: REPORT OF A CASE. P. KNAPP, Klin. Monatsbl. f. Augenh. **93:** 748 (June) 1935.

After reviewing briefly the papers of Gilbert and of Kokott on perivasculitis and endovasculitis of the retinal vessels, Knapp reports a case in point. A woman, aged 24, had always been healthy except for angina complicated with articular rheumatism in the twelfth year of life. After a recent attack of tonsillitis slight papillitis and severe thrombosis of a branch of the central retinal vein were noted in one eye. Buerger's disease was absent, but the roentgenogram showed closed tuberculous foci in the lungs, and Pirquet's test was positive. The tonsils were removed five months after the onset of the ocular disease. Nevertheless typical retinitis proliferans developed, and vision was strongly reduced several months later. Considering the anamnesis and the clinical observations, Knapp is inclined to attribute the ocular disease to the chronic tonsillitis. The tonsils were removed too late to allow a recovery of the eye, thus furnishing positive proof for the focal origin. This etiology seems to be probable since the strands in the retina began clearing at the time of publication of the paper.

K. L. STOLL.

THEORY AND PRACTICE OF TRAUMATIC DETACHMENT OF THE RETINA. ZUR NEDDEN, Klin. Monatsbl. f. Augenh. **94:** 794 (June) 1935.

Zur Nedden renders a detailed account of the present evaluation of the etiology of traumatic and spontaneous detachment of the retina. In limiting the traumatic factor again, as he did in a previous paper, he points out several sources of error in this diagnosis. Among these he discusses binocular detachment of the retina in cases of myopia; here the patient may attribute the detachment in one eye to overexertion or

to concussion of the body. Detachment had occurred in one eye of a patient a certain length of time prior to that in the second eye without accident or trauma of any kind. Myopia, on the other hand, cannot be a causative factor, as detachment has been observed in young persons with a low degree of myopia, whereas persons with a very high degree of myopia may never suffer from detachment of the retina. Zur Nedden concludes that myopia harbors no tendency toward a detachment on account of the symptoms of degeneration and traction complicating it. The presence of some other factor is required for the occurrence of detachment of the retina in myopia, a factor which cannot be demonstrated by present methods of examination; it cannot be any factor other than a congenital diathesis for detachment. This diathesis may be hereditary in a measure, as progressive myopia is known to be hereditary. Genealogies associated with retinal detachment have been published by Vogt, and symptoms common to senile and myopic detachment have been pointed out by several authors, so that a differentiation between them can no longer be maintained. The tendency toward detachment is independent of the refraction but subject to the laws of heredity. Therefore the degeneration progresses even after successful operative reattachment, as stated by Deutschmann and Larsson. Zur Nedden considers detachment of the retina and the cyclitis following it as stages in one pathologic complex. Senile and myopic detachment of the retina, in his opinion, form a common idiopathic disease which he calls "hereditary detachment of the retina."

K. L. Stoll.

Trachoma

Local Quinine Therapy in Trachoma. E. Selinger, Am. J. Ophth. **18:** 631 (July) 1935.

Following experiments on animals and human beings with a saturated aqueous solution of quinine bisulfate, Selinger make the following conclusions: "Quinine, besides being an astringent and a bactericide, is a protoplasmic poison which, because of its alkaloidal properties, penetrates deeply into the tissues on being applied locally to mucous membranes. It destroys pathological accumulations of lymphoid tissue by its action as a protoplasmic poison and this same property inhibits new invasions of the tissues by cellular elements. Animal experiments show that the normal and traumatized cornea is not injured by the concentrations of quinine bisulphate advocated in the treatment of trachoma. The treatment of trachoma with quinine bisulphate is less painful than that with the copper-sulphate stick and the duration of the diseases is considerably shortened. Some other diseases of the anterior segment of the eye seem to be favorably affected by the local application of quinine."

W. S. Reese.

Treatment of Trachoma with Sodium Taurocholate. E. Paparcone, Rev. internat. du trachome **12:** 202 (Oct.) 1935.

Since the inclusion bodies of trachoma probably represent some form of micro-organism, bile salt should be of therapeutic value because of its germicidal and germ-inhibitive action.

J. E. Lebensohn.

IMPRESSIONS ON TRACHOMA AT SANTIAGO DEL ESTERO (ARGENTINE REPUBLIC). J. A. SENÁ, Arch. de oftal. de Buenos Aires **10:** 711 (Sept.-Oct.) 1935.

This is a detailed report of a visit to Santiago, where trachoma flourishes, with an account of the forms existent there and of the prophylactic measures which are being carried out.

Sená confirms the observations of different authorities in other countries that trachoma generally originates in infancy or childhood, that it then takes a mild or latent form but is more contagious, and that the disease in adolescents and adults is more severe, with more complications, and not so contagious.

He stresses the importance of inspection and treatment in schools, supplemented by treatment at dispensaries and by inspection of the inmates of houses in which the infected children reside.

He approves the measures being carried out in Santiago and recommends a more generous supply of funds in order that the radius of action may be extended.

Examination of the inmates of two hospitals revealed that 12.11 and 14 per cent of the patients had unrecognized trachoma.

Senâ considers that the campaign being carried out in Santiago should be extended, improved and applied in other infected provinces of northern Argentina.

C. E. FINLAY.

Tumors

UVEAL SARCOMA—MALIGNANT MELANOMA. T. L. TERRY and J. P. JOHNS, Am. J. Ophth. **18:** 903 (Oct.) 1935.

From a statistical study of ninety-four cases, Terry and Johns draw the following conclusions:

"1. Malignant melanoma is a better name than sarcoma for primary malignant uveal tumors.

"2. The presence of a tumor was not even suspected clinically in 44.6 per cent of the cases.

"3. Malignant melanomata can be graded according to cellular morphology, although the value of this grading can be determined only by studies of more cases.

"4. The usual 'five-year-cure' period is not long enough to be presumptive evidence of a cure in cases of malignant melanomata.

"5. Cells of malignant melanomata are frequently left in the orbit after enucleation, although orbital recurrence is seldom observed.

"6. Metastases that become evident many years after enucleation may result from a more recent metastasis of orbital recurrence that is not recognized.

"7. Malignant melanomata have invaded the optic nerve and have even invaded the cranial cavity.

"8. The formation of pigment in malignant melanomata is probably related in some instances to degenerative processes in the tumor, is unrelated to the normal pigmentation of the eye, and is probably of no prognostic value.

"9. The growth of the tumor into the vitreous cavity is probably not always the cause of the glaucoma that occurs so frequently in tumor cases.

"10. Separation of the retina is the most common complication of malignant melanoma.

"11. Uveitis is a common complication of malignant melanoma."

W. S. REESE.

NEUROMA OF THE ORBIT. B. ADAMANTIADIS, Arch. d'opht. **52:** 582 (Aug.) 1935.

A case of neuroma of the orbit is described because of the extreme rarity of the condition. The author was unable to find any record of its occurrence in the literature. The condition occurred in a young girl 12 years old who had had exophthalmos for three years. A preoperative diagnosis of a slow-growing tumor was made. Its histologic structure is described.

S. B. MARLOW.

MALIGN MELANOMA OF THE EYELID IN CHILDHOOD WITH METASTASES AND A LETHAL TERMINATION. A. D. NOWKIRISCHKY, Klin. Monatsbl. f. Augenh. **94:** 521 (April) 1935.

A girl aged 11 had been treated and operated on for what her family physician called a benign papilloma. The small tumor had been removed on repeated occasions, the last time about six months after the treatment was begun. Two months later the tumor had returned and the child was brought to the ophthalmologic clinic of the University of Basel, Switzerland. Here the tumor was radically excised and three rayings of 230 roentgens each were applied. It was histologically an anaplastic malign melanoma with slight pigmentation and round and spindle-shaped cells, arising from a nevus of the eyelid. The result seemed to be perfect except for a small recurrent growth, which, however, showed no histologic evidence of the melanoma. No recurrence had occurred after five months' clinical observation as of Nov. 17, 1933.

A later report from the Children's Hospital at Freiburg, Germany, informed Nowkirischky that the child had been admitted to that institution on Dec. 11, 1933, and had died on Jan. 12, 1934. The scar on the eyelid was smooth and free from any irritation, but severe general symptoms existed, which were caused by metastases in nearly every organ, including the kidneys, liver, mammae, ovaries, thyroid gland, pancreas and gallbladder. Vacuoles causing a resemblance to syringomyelitis were observed in the spinal cord.

K. L. STOLL.

Uvea

UVEOPAROTID FEVER. D. G. COGAN, Am. J. Ophth. **18:** 637 (July) 1935.

Cogan reports a case of uveoparotid fever in a 29 year old woman who had bilateral parotitis, uveitis, fever and complete facial palsy on the right. Tuberculosis was diagnosed by the internists on the

basis of the symptoms. Cogan discusses uveoparotid fever from the standpoint of occurrence, causation, characteristics, sequelae and treatment.

W. S. REESE.

CLINICAL-ANATOMIC STUDY OF TUBERCULOUS INFLAMMATION OF THE IRIS. P. BONNET and A. COLRAT, Arch. d'opht. **52:** 385 (June) 1935.

The case of a young girl 23 years old is described in detail. She had healed calcified tuberculous glands and chronic tuberculous nephritis. Her right eye showed tuberculous iritis with hypopyon, then hypertensive iritis. The left eye was enucleated on account of secondary glaucoma. It is unusual to obtain an eye with tuberculous iritis for microscopic study. Clinically the case presented no special characteristics. It proves that subacute plastic iritis with early firm synechiae and secondary hypertension can be tuberculous. Anatomically the diffuse, confluent nature of the lesions was striking, the iris being involved to the greatest extent, the ciliary body and choroid much less. A second point of interest was the abundance of plasma cells. It is not possible to affirm that the confluent nature of the lesions and the abundance of plasma cells are histologic criteria of a tuberculous process, but the authors think that these features are worthy of attention inasmuch as they are not encountered in other types of inflammation of the iris.

S. B. MARLOW.

TRAUMATIC PROLIFERATION OF IRIS PIGMENT AND CYSTS OF THE IRIS. A. HUDELO, Arch. d'opht. **52:** 410 (June) 1935.

Three conditions are described in this report: a multilocular cyst with a lining of pigment developing in the stroma of the iris; a pigmented cyst of the iris with an accessory cyst of the anterior chamber, and a traumatic subendothelial cyst. These conditions are fully described and illustrated by photomicrographs. The discussion of the possible cause for the cysts in the first two instances leads Hudelo to the view that they arise from the proliferation of the chromatophores of the iris. His third case confirms the idea that the anterior part of the endothelium does not penetrate into the iris, as was once thought, but dips down into the crypts of the iris without solution of its continuity.

S. B. MARLOW.

Vision

RESTORATION OF CLEAR VISION AFTER OCULAR FATIGUE. T. B. SHUBOVA, Sovet. vestnik oftal. **5:** 568, 1934.

This is a preliminary report. Shubova examined two engravers by Ferree and Rand's method with the Landolt ring in the reverse order, i. e., the restoration of visual function after its disturbance by ocular work. The engravers had been engaged in their work for twenty-five years; both had normal vision (there was a refractive error of 0.5 diopter); they were presbyopic and used a lens 10 or 11 diopters in strength; they were seated in a chamber illuminated with an even reflected light, 135 kilovolts. The size of the opening in Landolt's ring

was 1 mm. They worked for three and a half hours. The first examination was done before the work, half an hour after adaptation to light; then three more examinations were made, one after each hour of work, and a fourth examination was made after work. There were several series of experiments with series of rest of twenty minutes', forty minutes', fifty minutes' and one hour's duration. The length of the series was five days.

Three tables demonstrate the results. The abscissas show the time of the experiment and the ordinates the stability of clear vision in percentage. In one subject stable clear vision was restored in fifty minutes, and in the other visual function reached 95 per cent of the normal in one hour. In both subjects the process of restoration of clear vision was more rapid in the first few minutes than in the following ones.

O. SITCHEVSKA.

Visual Tracts and Fields

VISUAL DISORIENTATION IN HOMONYMOUS HALF-FIELDS. G. RIDDOCH, Brain **58:** 376 (Sept.) 1935.

Several writers have described in connection with lesions of the brain an inability of the patient to localize correctly objects seen in the three planes of space and to estimate absolute and relative distance. This impairment, in this article, is designated "defective spatial orientation in the visual fields." Notably Gordon Holmes, writing in 1918 and 1919, described such an impairment in certain patients who had war wounds of the head with involvement of both parietal lobes. Associated with the defective spatial orientation, but not all in the same case, were such other functional disorders as visual inattention, difficulty in bringing an object into central vision and in maintaining fixation on it when it was moved, defective pupillary reaction in accommodation, reduction of the blinking reflex and visual agnosia. Visual acuity was, as a rule, not greatly impaired.

While Holmes found that the impairment involved the visual field as a whole and was associated with a bilateral lesion of the brain, Riddoch reports that defective orientation may occur in the homonymous half field alone and be the result of a unilateral lesion of the opposite parietal lobe of the brain. The records of two cases are presented in both of which the defect appeared unmistakable. In both cases the defect was present without any significant limitation of the visual fields, and visual acuity was fair. Both were cases of tumor with marked papilledema. In both cases the new growth extensively invaded the parietal lobe on the side opposite to the half field with the orientation defect.

He points out that visual localization in the coronal plane is largely a function of the retina. Estimation of absolute and relative distance, on the other hand, is much more complex and is the result of the integration of immediate sensations and impressions from the retina, ocular muscles, labyrinth, neck and body with accumulated past experience.

He concludes, "Visual disorientation may occur when the association pathways from the calcarine visual cortex to other parts of the brain are interrupted and, so far as is at present known, the nodal point appears to be in the region of the supramarginal and angular gyri in the parietal lobe."

H. L. BEGLE.

Therapeutics

RETINAL VASOCONSTRICTION TREATED BY INJECTIONS OF COBRA VENOM. H. VIALLEFONT, Arch. Soc. d. sc. méd. et biol. de Montpellier **16:** 315, 1935.

In a woman, aged 61, with hypertension and intermittent claudication, the symptoms of deficient circulation were accompanied by a reduction of visual acuity to 20/100 for each eye. Cobra toxin, injected in doses of 5 rat units weekly, in one month produced an amelioration of the subjective systemic symptoms and an improvement of visual acuity to 20/40 for the right eye and 20/50 for the left. J. E. LEBENSOHN.

SUPERIOR HEMIANOPIA FOLLOWING TRAUMATISM OF THE OCCIPUT. J. MALBRAN and R. CARRILLO, Arch. de oftal. de Buenos Aires **10:** 642 (Aug.) 1935.

This is the report of a case of superior hemianopia with a scotoma near the point of fixation following a fracture in the occipital region. The central lesion included the lower lips of the calcarine fissure on both sides in their median portion, with involvement of the extremity of the lobule, the site of the cortical projection of the macula, the authors considering a hematoma in the middle line with symmetrical compression of the calcarine fissures (lower lips) on both sides as the only lesion which could produce the defect in the visual field. They review at length the lesions which can produce similar perimetric findings. C. E. FINLAY.

RECURRENT HEMORRHAGES OF THE VITREOUS TREATED WITH VITAMIN C. H. VILLARD, H. VIALLEFONT and E. DIACONO, Arch. Soc. d. sc. méd. et biol. de Montpellier **16:** 396, 1935.

A man, aged 24, whose diet had been deficient in fats suffered recurrent hemorrhages in the vitreous of the right eye. The condition became arrested after the administration of vitamin C. J. E. LEBENSOHN.

FIVE ERRORS IN THE TREATMENT OF SYPHILIS OF THE EYE. I. I. KAZAS, Sovet. vestnik oftal. **7:** 230, 1935.

Kazas believes that the essential cause of errors in the treatment of patients with syphilitic involvement of the eyes lies in ignoring the theory of biotropism. The first error is the starting of treatment with administration of bismuth or arsphenamine instead of mercury; biotropic reactions with undesirable complications may occur as a result. The second error is the provocative test for diagnostic purposes, as it may cause a transitional thriving of the spirochetes. The third error is the use of insufficient doses because of the fear of the toxicity of the arsphenamines. The knowledge of the chief pharmacologic effects of the arsphenamines, vagotonicity and acidophilia, will lead to avoidance of numerous complications. It is important to distribute the injections over a not too prolonged period of time. Monotherapy is the fourth

mistake. The fifth error is the inability to distinguish between complications due to insufficient doses of arsphenamine and those due to overdosage.

The mode of treatment of the syphilitic patients in Kazas' clinic for diseases of the eye is described in detail. Daily injections of a soluble mercury preparation are given the first two weeks; this is followed by the administration of arsphenamine, bismuth and iodide in this order. The basic rule is to saturate the patient with as much neoarsphenamine as he can stand. A careful study is made of each patient with regard to the dosage, his sensitivity to the drug and his constitution. This method has been applied in the clinic for fourteen years, and no complications have been observed.

O. SITCHEVSKA.

Toxic Amblyopia

CEREBROSPINAL-FLUID STUDIES IN TEN CASES OF TOBACCO-ALCOHOL AMBLYOPIA. F. D. CARROLL, Am. J. Ophth. **18:** 720 (Aug.) 1935.

Carroll found a tendency toward elevation of the level of protein in the cerebrospinal fluid in ten patients with tobacco-alcohol amblyopia. The protein level was highest in two patients whose cerebrospinal fluid was examined before they had decreased their intake of tobacco and alcohol.

W. S. REESE.

TRANSITORY POSITIVE CENTRAL SCOTOMA (WEEKER'S SIGN) IN RETROBULBAR NEURITIS DUE TO ACUTE METHYL ALCOHOL POISONING. N. P. JOIRIS, Arch. d'opht. **52:** 578 (Aug.) 1935.

A case is described of acute retrobulbar neuritis due to methyl alcohol. In the earliest stages the patient was blind. When the patient became cooperative the peripheral fields were found to be normal, but a small central scotoma was present in the right eye and a large one in the left. Weeker's sign was at no time demonstrable in the right eye and became detectable in the left only after the central scotoma grew smaller. Joiris believes that this sign is a delicate differential diagnostic aid in dealing with retrobulbar neuritis. It is present in toxic amblyopia due to alcohol and nicotine and in methyl alcohol poisoning, whereas it is absent in amblyopia due to multiple sclerosis, syphilis or diabetes.

S. B. MARLOW.

Society Transactions

EDITED BY DR. JOHN HERBERT WAITE

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

Dec. 19, 1935

J. MILTON GRISCOM, M.D., *Chairman*

ALEXANDER G. FEWELL, M.D., *Clerk*

A PITUITARY ADENOMA OF LONG DURATION. DR. E. DE SCHWEINITZ and DR. A. G. FEWELL.

W. H. D., aged 55, came under observation on Sept. 9, 1935, his chief complaint being failing vision, progressive for from five to six months. The vision in the right eye at the time of examination was 6/30 and that in the left 6/9. The patient had been examined several months earlier by another ophthalmologist, who found optic atrophy and central scotomas, which were interpreted as retrobulbar neuritis, cause unknown. No roentgenogram of the skull was then made. For years the patient had suffered from headaches, severe and neuralgic in character, and preceded by dimness of vision. On ophthalmoscopic examination both disks showed primary optic atrophy. The field for form was concentrically contracted in each eye, and in the right eye there was a large centrocecal scotoma for red. In the left eye the lower nasal portion of the visual field was entirely absent, and this blind area was connected with a very much enlarged blindspot. There was bitemporal hemianopia for red. A roentgenogram showed destruction of the pituitary fossa—the dorsal portion of the sella and posterior clinoid processes had disappeared. The right anterior process was intact, and the left seemed elevated. These findings led us to suspect an expanding lesion of the pituitary. Roentgen treatments were tried for a time, but they upset the patient, inducing violent nausea, and had to be discontinued. Dr. C. H. Frazier at the Hospital of the University of Pennsylvania operated and removed a large adenoma of the pituitary, extending into the posterior fossa. The patient did well for a time following operation, but unfortunately pneumonia developed, and he died.

DISCUSSION

DR. WILLIAM ZENTMAYER: In 1910, under the title "A Case of Bitemporal Hemianopsia with an Unusual Clinical History," I reported the case of a married woman aged 27, first seen at the Wills Hospital in 1890 with vision of 5/50 in each eye. There was bitemporal hemichromatopsia.

Somewhat later a binasal relative scotoma was present. This finding was transient. In 1895, after a lapse of four years in the records, there were bitemporal hemianopia for form and color. The papilla showed 1 diopter of prominence on the nasal side. In 1903 the remaining field had contracted to within 20 degrees of the fixation point. In March

1909 part of the lost field was recovered, the vision extending in the horizontal meridian from 18 degrees of the fixation point on the temporal side to about 25 degrees on the nasal side, and central vision had increased to 6/9 in the right eye and 6/6 part in the left.

The recovery of part of the blind area was ascribed by Spiller to erosion of the floor of the sella or by implication of the brain above by which pressure on the chiasm was relieved.

Dr. Walter I. Lillie: To Dr. de Schweinitz' interesting descriptions of the various types of headaches associated with pituitary tumors I should like to add the account of a unique experience related to me by Dr. A. W. Adson. During the removal of the intrasellar portion of a pituitary tumor his patient spontaneously remarked that she was experiencing the deep-seated, centrally located headache which was the characteristic pain before operation. Headache of this type is probably due to intrasellar pressure on the dura.

Sequelae of Interstitial Keratitis With Retinal Exudate and Massive Hemorrhage. Dr. William Zentmayer.

A girl of 11 years, with a 4 plus Wassermann reaction, was first seen on Sept. 5, 1930. The right eye showed active interstitial keratitis, with vision reduced to perception of light. Detailed study of the fundus was not possible, but there was the impression of a large hemorrhage between the disk and the macula.

Two months later the vision in the left eye suddenly failed and was found to be 6/60. There was no evidence of keratitis. There was a circumscribed exudate above the macula, with a large hemorrhage below the macula, involving the fovea.

At the present time the fundus in the right eye shows a vertical linear scar, averaging about 3 vessel diameters in width and about 3 disk diameters in length, situated about 1½ disk diameters from the temporal border of the disk. The central portion is white, and the border on each side is densely pigmented. The upper portion flares somewhat, and this area shows some overlying proliferative tissue. The disk is overcapillary, the edges being fairly well defined. At the equator, paralleling the branch of the inferior temporal artery, there is a ribbon-like band, paler than the surrounding fundus, probably a sclerosed choroidal vessel.

In the left eye just above the fovea there is a perfectly round greenish-white atrophic area, 1 disk diameter in width, with a rather densely pigmented border. Fine retinal vessels are made out on its surface. There is some proliferation over the lower portion of the lesion. The correct vision is 6/12 part in the right eye and 6/60 in the left eye.

Lupus Erythematosus of the Eyelids and Conjunctiva. Dr. Perce DeLong and Dr. J. V. Klauder.

A white woman aged 27 had for one year showed discoid patches of lupus erythematosus on the forehead, nose and each side of the face. The areas were atrophic, slightly red and at places covered with adherent fine scales. Both lids of both eyes were involved; the cilia were absent; the surfaces were dry and irregular. The conjunctiva of the lower lid of the right eye was involved, being elevated, smooth and

glistening with a velvet-like edema and dark red to purplish. On the posterior aspect of the right buccal mucosa there was a sharply marginated patch, with its periphery slightly elevated and violaceous, and fine vessels ran over the periphery onto the normal mucosa.

During the past six months bismuth has been administered intramuscularly. Moderate improvement has followed this therapy. Similar cases have been reported by the presenters (Klauder, J. V., and DeLong, Perce: Lupus Erythematosus of Conjunctiva, Eyelids and Lid Margins, ARCH. OPHTH. **7**: 856 [June] 1932).

ARGYRIA OF THE CONJUNCTIVA. DR. PERCE DELONG and DR. J. V. KLAUDER.

A white woman aged 39 shows slate-colored conjunctivae. The discoloration first appeared about three years ago. At intervals for four or five years prior to its appearance she used argyrol (mild protein silver) in the eye in treatment of a corneal ulcer, which was part of an acne rosacea. She also instilled argyrol into the nose whenever she had a cold. The mouth, tongue, gums and skin showed no discoloration similar to that of the conjunctivae.

Jan. 16, 1936

CHARLES R. HEED, M.D., *Chairman*

ALEXANDER G. FEWELL, M.D., *Clerk*

RELATIONSHIP OF THE EYE TO THE PARANASAL SINUSES. DR. O. V. BATSON.

A long series of studies dating particularly from the well known investigations of Onodi has shown the close anatomic relationships existing between the paranasal sinuses and the orbits. These relationships make the spread of malignant growths and invading benign tumors easily understandable; also that of slowly developing abscesses. The mere adjacency of structures, however, is not sufficient to explain their reciprocal involvement in acute conditions.

A thin lamina of bone and relatively dense periorbita separate the sinus cavities from the orbital structures. In considering the possible pathways by which pathologic processes might spread one can probably disregard the arteries. Further, except for the conjunctiva and lids, one may conclude that there is not sufficient evidence to prove the existence of lymphatics in the orbit. This leaves for consideration the venous system. A series of injection experiments, performed on cadavers, is highly suggestive of the possible rôle that the venous circulation may play. The angular vein was ligated at the lower border of the orbit, and an opaque substance was injected into the anterior facial vein. Its intravenous spread was studied on roentgenograms and in cleared specimens. Under these conditions the superior ophthalmic vein and many of its tributaries were filled through the connections around the lateral wall of the orbit and through small undescribed veins which in a

general way parallel the angular vein. Further connections by way of superficial nasal veins carried the injected material to the angular vein of the opposite side. The cavernous sinus was readily filled. Probably most significant from the standpoint of the relation of diseases of the paranasal sinuses to orbital complications is the demonstration of the plexus of veins about the nasolacrimal duct and the communication of these plexuses with the cavernous plexuses of the turbinates as well as with the veins in the wall of the maxillary sinus. The connections between the vessels of the linings of the sinuses and the cavernous plexuses of the nose afford a rather complete picture of the pathways which may connect the paranasal sinuses with the orbits. Therefore, on an anatomic basis, the many direct connections of the veins of the nose and paranasal sinuses with the veins of the orbit and cavernous sinuses of the cranium seem to present the probable pathway for the involvement of the orbit in infectious conditions of the nose.

RHINOGENIC COMPLICATIONS FROM THE OPHTHALMOLOGIC STANDPOINT. DR. E. B. SPAETH.

This paper will be published in full in a later issue of the ARCHIVES.

RELATIONSHIP OF SINUSITIS TO OPTIC AND RETROBULBAR NEURITIS: WITH SPECIAL REFERENCE TO ETIOLOGY AND TREATMENT. DR. E. H. CAMPBELL.

This paper is published in full, with the discussion, in this issue of the ARCHIVES, page 236.

Feb. 20, 1936

CHARLES R. HEED, M.D., *Chairman*

ALEXANDER G. FEWELL, M.D., *Clerk*

DESCRIPTION OF A ONE METER PERIMETER. DR. ALFRED COWAN.

A method is demonstrated for converting a tangent screen into a perimeter to be used at 1 meter by the use of a detachable arc.

TREATMENT OF DETACHMENT OF THE RETINA BY SCLEROTOMY AND THE APPLICATION OF THE THERMOPHORE. DR. H. M. LANGDON.

In November 1934 I reported a case in which a partially detached retina had been successfully treated by sclerotomy and multiple one minute applications of a thermophore at a temperature of 165 F.

In November 1935 I operated in a similar way on the entirely detached lower half of a retina in which no tear could be discovered. The first symptoms had been present about four months before operation, and two months before operation the condition was diagnosed as retinal detachment. There was complete reattachment of the retina. with restoration of the field for form and a 15° field for red and central vision of 5/22, corrected.

In a third case the detached upper portion of a retina was operated on with apparently a good result. This case will be reported in detail later.

DISCUSSION

DR. F. H. ADLER: It is interesting that external application of heat was one of the first methods employed to produce experimental detachment of the retina. The application of heat produces a serous effusion which will lift off the retina. If one is going to treat retinal detachment by this means it is of the utmost importance to create an outlet for this fluid, and I take it that Dr. Langdon provides an outlet for the fluid at the time the thermophore is applied. I should like to know if in both cases the detachment was traumatic in origin? Was a tear present in the case reported tonight? Is there any difficulty in applying the thermophore after sclerotomy?

DR. H. M. LANGDON: The patient whose case was reported previously had been exposed to trauma in the navy, where he engaged in a great deal of boxing. He also had very badly infected teeth. His vitreous showed a distinct haze, suggesting a low grade choroiditis, so that the detachment may have been due to accumulation of subretinal exudate.

I agree with Dr. Adler that it is most essential to have drainage, and better to have it before than after application of the thermophore. One is very much more apt to have the retina in apposition with better chances for adhesions to form between it and the choroid if drainage is provided beforehand. Post, in working with the thermophore on animal eyes, found that the application of the thermophore for one minute at 160 F. produced a decided reaction in from thirty-six to forty hours. It was this to a certain extent that gave me the idea that treatment with the thermophore may be good in cases of the type described. There is no difficulty in applying the thermophore after the fluid has been released.

EXPERIMENTAL STUDIES ON CHOKED DISK. DR. W. A. JEFFERS, DR. J. Q. GRIFFITH, DR. W. E. FRY and DR. A. G. FEWELL.

Following intracisternal injection of kaolin in the albino rat high blood pressure develops with an increase in intracranial pressure, but there is no retinal venous engorgement or choking of the disks.

The failure of thorium dioxide to enter the cervical lymphatics and the epidural connective tissue of the optic nerve of such hypertensive rats suggests that there is obstruction to the usual outflow of the cerebrospinal fluid.

These animals made hypertensive by kaolin do not present the usual retinal venous engorgement or papilledema on implantation of cerebellar tumors. This suggests that the block produced by kaolin may be the responsible factor.

The exact site of the obstruction to lymphatic flow has not yet been ascertained, but it is probably in the perivascular spaces of the lamina cribrosa and the adjacent dural region.

When thorium dioxide is injected into the cistern of a normal animal after the withdrawal of an equivalent amount of cerebrospinal fluid it will lodge in greatest concentration just central to the lamina

cribrosa and inside the intervaginal sheath. This is evidence that fluid normally flows from the region of the brain toward the eye and not vice versa.

The fact that thorium dioxide does not collect around the peripheral end of the optic nerve in the kaolin-prepared animal suggests that the usual forward current of lymphatic flow is obstructed.

In this paper the significance of these findings is discussed in the light of theories concerning the pathogenesis of papilledema.

DISCUSSION

DR. GEORGE DE SCHWEINITZ (after giving a brief history of his and Dr. Holloway's experimental endeavor to create choked disks by raising the intracranial pressure): We found that dogs were not satisfactory. Our best results were obtained with monkeys.

We raised the intracranial pressure by injecting physiologic solution of sodium chloride and by introducing foreign substances into the brain. A very moderate congestion of the disk developed. The affected tissues were not examined microscopically.

Dr. Walter Parker in work along similar lines was satisfied that he had produced moderate choking of the disk.

DR. W. E. FRY: I might add something in regard to the histologic examination of these eyes. What one sees in the rats does not look like choked disks as seen in human eyes, but certain characters suggest the appearance of edema of the nerve fibers. This is definite, although not particularly marked.

What we did see was enormous engorgement of the retinal veins. This was definite and marked. Dr. Jeffers and Dr. Griffith have developed a technic by which one can study very satisfactorily one phase of choked disk: That is engorgement of the retinal veins.

DR. A. G. FEWELL: As Dr. Jeffers has told you, it is almost impossible to outline the disk in the rat's eye. Its eye is very hyperopic. The crystalline lens seems to occupy the greater part of the globe. The retina is best seen with a plus 7 or 8 diopter lens.

DR. F. H. ADLER: In 1924 Parker showed that the swelling of the disk depended somewhat on the intra-ocular pressure inasmuch as it was always greater on the side on which the intra-ocular pressure had first been reduced by an Elliot trephining. I have under observation a patient who demonstrated that this is true not only of choking due to raised intracranial pressure but also to the swelling produced in hypertensive neuroretinitis. This patient was operated on four years ago for chronic simple glaucoma. An Elliot trephining was done on the right eye. The tension in this eye has remained subnormal. Within the last year arteriosclerotic retinitis has developed in both eyes, but the right disk is swollen about a diopter and a half, whereas there is no swelling of the left disk. All of the veins on the right side are much more dilated and there are many more hemorrhages than on the left.

It is unfortunate that the authors have to use such small animals, as it might be interesting to note whether reducing the tension in one eye may not produce choking.

WILLIAM PORTERFIELD, M.D.—AN ALMOST FORGOTTEN OPTICO-PHYSIOLOGIST. DR. BURTON CHANCE.

This article is published in full in this issue of the ARCHIVES, page 197.

EXTRACTION OF NONMAGNETIC INTRA-OCULAR FOREIGN BODIES: REPORT OF THREE CASES. DR. J. S. SHIPMAN.

Three patients have been operated on for copper in the vitreous. The first and the third patient received their injury while working with fine copper wire on coil-winding machines. The second was injured by explosion of a dynamite cap. All three patients were operated on as follows: After posterior sclerotomy a small capsule forceps was inserted through the lips of the wound, and while looking with the ophthalmoscope through the pupil I was able to grasp the foreign body in the vitreous and extract it through the sclerotomy opening. In the first patient the sclerotomy wound was closed with interrupted black episcleral sutures, and in the last two it was first closed with the actual cautery.

The first patient made an uneventful recovery, and for five weeks following the operation the vision was normal, but at the end of this time retinal detachment was noticed. This became more marked, and approximately two months after the original accident the first operation for retinal detachment was done with Weve needles. This was unsuccessful, and two more operations were done, the last with Šafář needles. No permanent success followed any of the operations. Three years after the patient's injury examination showed a complicated cataract with divergence of the injured eye and only bare perception of light.

The second patient made an uneventful recovery, and in spite of the fact that he had a partial posterior cortical cataract from the time he was first seen he still has useful vision, 6/15 with correction, two years after his injury. There has been no evidence of retinal detachment at any time, and the visual field in this eye is full. The cataractous changes have remained practically the same.

The third patient came under observation more recently, having been injured in November 1935. More reaction was experienced following operation on this patient, and the partial cataract which was present at the time of the first examination became complete following operation, necessitating a linear extraction. Following this the patient made an uneventful recovery. At the present time the eye is quiet, and with a plus 13 diopter sphere the vision is 6/6—. The visual field is practically full, and there is no ophthalmoscopic evidence of retinal detachment.

DISCUSSION

DR. ALFRED COWAN: A foreign body in the vitreous as seen with the ophthalmoscope appears by refraction to be farther forward than it is. This can be seen easily when a diagram is drawn to show how the rays on leaving the eye are bent toward the perpendicular. The foreign body will always be projected along the emergent ray. Roughly it will appear to be 25 per cent nearer to the front of the eye than it is.

CORRECTION

In the report of the proceedings of the Section on Ophthalmology at the Eighty-Sixth Annual Session of the American Medical Association, which appeared in the May issue (ARCH OPHTH. **15**:951, 1936), mention of the chairman's address, by Dr. Arthur J. Bedell, "Stereoscopic Fundus Photography," was omitted. This article was published in full in *The Journal of the American Medical Association* (**105**:1502 [Nov. 9] 1935).

Book Reviews

Handbuch der microscopischen Anatomie des Menschen. Edited by Wilhelm von Mallendorff, Zurich. **Volume III, Part 2: The Eye.** By the late Prof. Walter Kolmer, Vienna, and Prof. Hans Lauber, Warsaw. Price, 150 marks. Pp. 782, with 475 illustrations, some in color. Berlin: Julius Springer, 1936.

This large octavo volume on the microscopic anatomy of the eye is the most monumental work that has been written on the subject. With a good index and complete references to the literature it is likely to remain long the authoritative reference book of its kind.

The work was begun by Prof. Kolmer, of Vienna, who was especially versed in the comparative anatomy of the eye. He wrote the section on the retina and that on the embryology and also prepared most of the bibliography, while the greater number of the excellent diagrams, drawings and photomicrographs used as illustrations are attributed to him as well.

After Kolmer's death the task was taken over and brought to a successful conclusion by Prof. Hans Lauber, of Warsaw, to whom is due, therefore, the principal credit for the production of this exhaustive treatise.

WARD A. HOLDEN.

Handbuch der Neurologie. Edited by Prof. O. Bumke, Munich, and Prof. O. Foerster, Breslau. **Volume IV: Symptomatology. Part II: Cerebral Nerves and Pupils.** By A. Bielschowsky, P. A. Jaensch, W. Klestadt, F. Kramer, O. Marchesani and W. Riese. Price, 135 marks. Pp. 701, with 173 illustrations, some in color. Berlin: Julius Springer, 1936.

This large reference book, which is similar in most respects to that just mentioned from the same press, gives, like the former, an exhaustive presentation of the subject matter.

It is provided with a complete index of subjects and an exceptionally full index of authors.

The illustrations, many of which are new, consist of diagrams, photomicrographs, roentgenograms and photographs of patients, instruments and methods of examination, as well as several pictures of the fundus in color.

The first section, of thirty-seven pages, by Dr. W. Riese, of Lyons, is on the symptomatology of diseases of the olfactory nerve and of its cortical representation.

The second section, of ninety-two pages, by Professor Marchesani, of Munich, treats in great detail of the symptomatology of diseases of the optic nerve. Next is a section of forty-three pages by Professor Jaensch, of Essen, on methods of examination of the optic functions.

The following section, of ninety-four pages, on disorders of ocular movements, is by Professor Bielschowsky, formerly of Breslau and

at present in Hanover, N. H., who is well known to English readers through his recent important contributions to the ARCHIVES.

The pupils are fully discussed by Professor Jaensch in a section of seventy-three pages. Dr. Kramer, of Berlin, devotes nineteen pages to the fifth, eighth, ninth, eleventh and twelfth cerebral nerves, and Dr. Klestadt, of Magdeburg, concludes the text with a long section of three hundred and four pages on the symptomatology of diseases of the eighth nerve,

This volume is another authoritative work of lasting value, containing all that is essential on the subjects to date.

WARD A. HOLDEN.

News and Notes

SOCIETY NEWS

Chicago Ophthalmological Society.—The Chicago Ophthalmological Society announces the establishment of the William Hamlin Wilder Foundation, a memorial to the late Dr. W. H. Wilder. The purpose is to establish and maintain a lectureship in ophthalmology or an allied subject, the lecture to be given in Chicago every two years. To that end a fund of $10,000 is being raised, the interest of which is to be used solely for the payment of an honorarium to the lecturer and for the expenses of publication of the lecture. The administrative details are vested in a committee composed of the president and the three most recent past presidents of the Chicago Ophthalmological Society. The financial details are to be managed by the Northern Trust Bank of Chicago. Friends and colleagues of the late Dr. Wilder who wish to aid in this perpetuation of his memory are invited to send their contribution to the Wilder Foundation, Northern Trust Bank of Chicago.

International Organization of the Campaign Against Trachoma.—The meeting of the International Organization of the Campaign Against Trachoma was held in Paris on Monday, May 11, 1936, during the session of the Annual Congress of the Société Française d'Ophthalmologie.

After an introductory address by the president, Dr. A. F. MacCallan, papers of interest on the treatment of trachoma in children were read by Dr. MacCallan, Dr. Wibaut (Holland) and Dr. Zachert (Poland). The subject was discussed by Dr. Ragazzi and Professor Baslini (Italy), Dr. Joseph Jitta (League of Nations, Dr. Aubaret (France), Dr. Nataf (Tunis) and Dr. Marin Amat (Spain). These addresses will be published in a forthcoming number of the *Revue internationale du trachome,* which has been made the organ of this association.

International Association for the Prevention of Blindness.—The International Association for the Prevention of Blindness met in conjunction with the French Ophthalmologic Society in Paris on Monday, May 11; a large assembly was present. The annual address was read by the president, Professor de Lapersonne; Profs. Nordenson, Marx, Paton, Terrien, Van der Hoeve, MacCallan, Van Duyse, Márquez and others participated.

Mr. Paton, of London, who is the honorary chairman of the International Ophthalmologic Congress to be held in Cairo in 1937, was made a member of the Executive Committee. The president emphasized the view expressed by Park Lewis that the aim of the association is not so much to discover new rays to preserve the sight, since that is the sphere already occupied by medical and scientific colleagues, as to utilize the vast amount of experience already accumulated and give it practical application.

Professor Terrien read a valuable paper entitled "The Classification of Forms of Conjunctivitis." Dr. Rowland P. Wilson, notwithstanding illness, came from Cairo and read an important paper on "Conjunctivitis of Children in the Orient," pointing out the seasonable character and the influence on the development of trachoma. Dr. MacCallan urged the importance of an early diagnosis in trachoma and distinction between other forms of conjunctivitis. Among those who discussed these papers were Professor Bartels, of Dortmund, Germany; Dr. Marin Amat, of Spain; Dr. Lacat, of Paris; Dr. Toulant, of Algiers; Dr. Moutinho, of Lisbon, and Dr. Nataf, of Tunis.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.

International Ophthalmologic Congress

Secretary: Dr. E. Marx, Costzeedijk 316, Rotterdam, Holland.
Place: Cairo. Time: December 1937.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. P. E. H. Adams, 6, Holywell, Oxford.
Secretary: Dr. Thomasina Belt, 13, Mitchell Ave., Jesmond, Newcastle-on-Tyne.
Place: Oxford. Time: July 22-24, 1936.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. R. Foster Moore, 53, Harley St., London, 1.
Secretary: Miss Ida Mann, 7, Wimpole St., London, 1.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Ransom Pickard, 31, East Southernhay, Exeter, England.
Secretary: Dr. A. Rugg-Gunn, 35, Harley St., London, W. 1.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

President: Prof. Lohlein, Jena.
Secretary: Prof. A. Wagenmann, Heidelberg.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

CHINESE OPHTHALMOLOGICAL SOCIETY OF PEIPING

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen, Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

TSINAN OPHTHALMOLOGICAL SOCIETY

Chairman: Dr. Eugene Chan, Cheeloo University School of Medicine, Tsinan, Shantung.
Place: Cheeloo University School of Medicine. Time: Last Thursday of alternate months.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. William L. Benedict, 102 Second Ave., S. W., Rochester, Minn.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Atlantic City. Time: June 7-11, 1937.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: New York. Time: Sept. 26 to Oct. 3, 1936.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. L. S. Greene, 1710 Rhode Island Ave., N. W., Washington, D. C.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. William Fellowes Morgan, 50 W. 50th St., New York.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.

SECTIONAL

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. James J. Regan, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. William P. Beetham, 5 Bay State Road, Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. A. J. Ridges, Walker Bldg., Salt Lake City, Utah.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Salt Lake City, Utah. Time: Spring, 1937.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. L. H. Klemptner, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Purman Dorman, Virginia Mason Hospital, Seattle.
Place: Seattle. Time: January 1937.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. W. R. Fringer, 228 S. Main St., Rockford, Ill.
Secretary-Treasurer: Dr. W. H. Elmer, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Robert Griswell, 707 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. L. H. Hohf, Yankton, S. D.
Secretary-Treasurer: Dr. J. C. Decker, Francis Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Secretary: Dr. O. M. Marchman, Medical Arts Bldg., Dallas, Texas.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. O. B. McGillicuddy, 1908 Capitol Band Tower, Lansing, Mich.
Secretary-Treasurer: Dr. Maurice C. Loree, 120 W. Hillsdale St., Lansing, Mich.
Time: Third Thursday of alternate months.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Leslie R. Hazlett, 100 S. Main St., Butler.
Secretary-Treasurer: Dr. C. W. Beals, 41 N. Brady St., DuBois.

STATE

COLORADO OPHTHALMOLOGICAL SOCIETY

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Walter L. Hogan, 750 Main St., Hartford.
Secretary-Treasurer: Dr. Shirley H. Baron, 309 State St., New London.
Time: May, November.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. B. H. Minchew, 701 Elizabeth St., Waycross, Ga.
Secretary-Treasurer: Dr. Edward S. Wright, 1001 Medical Arts Bldg., Atlanta, Ga.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. J. R. Dillinger, French Lick.
Secretary: Dr. Frederick V. Overman, 705 Hume-Mansure Bldg., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Edwin Cob, 307 Masonic Temple, Marshalltown.
Secretary-Treasurer: Dr. O. L. Thorburn, 213½ Main St., Ames.
Place: Marshalltown. Time: September 1936.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. H. E. Binger, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. Edward S. Murphy, Northern Pacific Hosp., Missoula.
Secretary: Dr. A. W. Morse, 507 Phoenix Bldg., Butte.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. C. Coulter Charlton, 124 S. Illinois Ave., Atlantic City.
Secretary: Dr. H. L. Harley, 124 S. Indiana Ave., Atlantic City.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Secretary: Dr. Walter S. Atkinson, 168 Sterling St., Watertown.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Burton W. Fassett, Geer Bldg., Durham.
Secretary-Treasurer: Dr. Casper W. Jennings, 332 N. Elm St., Greensboro.
Place: Durham. Time: October 1936.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Trygve Oftedal, 55½ Broadway, Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 514 6th St., Valley City.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. R. E. Houston, 103 E. North St., Greenville.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. W. Potter, 601 Walnut St., Knoxville.
Secretary-Treasurer: Dr. W. D. Stinson, 248 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. T. E. Fuller, 100 W. Board St., Texarkana, Texas.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. V. P. White, 143½ S. Main St., Salt Lake City.
Secretary-Treasurer: Dr. E. B. Fairbanks, Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Emory Hill, 501 E. Franklin St., Richmond.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Secretary: Dr. J. E. Blaydes, First National Bank, Bluefield.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. B. E. Failing, 31 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark, N. J.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. William O. Martin Jr., 478 Peachtree St., Atlanta, Ga.
Secretary: Dr. A. V. Hallum, 478 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. Time: Second Friday of each month from October to May.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Jesse W. Downey Jr., 529 N. Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. Walter V. Moore, 1 Nevins St., Brooklyn.
Secretary-Treasurer: Dr. Mortimer A. Lasky, 1 Nevins St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

BUFFALO OPHTHALMOLOGIC CLUB

President: Dr. Thurber LeWin, 112 Linwood Ave., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

CHATTANOOGA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Each member, in alphabetical order.
Secretary: Dr. A. H. Benz, 706 Medical Arts Bldg., Chattanooga.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

CHICAGO OPHTHALMOLOGICAL SOCIETY

President: Dr. Robert B. Blue, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati Ophthalmic Club

Chairman: Each member, in rotation.
Secretary-Treasurer: Dr. E. R. Thomas, 819 Carew Tower, Cincinnati.
Place: Holmes Memorial Library, Cincinnati General Hospital. Time: 8:15 p. m., third Monday of each month except June, July and August.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. D. Ruedemann, 2020 E. 93d St., Cleveland.
Secretary: Dr. Fred W. Dixon, 1029 Rose Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. A. B. Bruner, 629 Euclid Ave., Cleveland.
Secretary: Dr. M. W. Jacoby, Hanna Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. F. W. Thomas, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Newton, Mercantile Bldg., Dallas, Texas.
Secretary: Dr. Maxwell Thomas, 1719 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. E. G. Linn, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. A. W. Greene, 148 Barrett St., Schenectady.
Secretary-Treasurer: Dr. Joseph L. Holohan, 317 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. T. L. Goodman, 602 W. 10th St., Forth Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. John H. McRae, 26 Sheldon Ave., S. E., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Robert G. Laird, 307 Metz Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. R. M. Hargrove, 1202 Esperson Bldg., Houston, Texas.
Secretary: Dr. J. C. Dickson, 1617 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. J. C. Daniel, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. H. B. Davis, 1101 Grand Ave., Kansas City, Mo.
Secretary: Dr. Byron Black, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. K. C. Brandenburg, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Ben K. Parks, 619 Professional Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. William A. Boyce, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. John P. Lordan, 2007 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. J. S. Bumgardner, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. Max Bornstein, Heyburn Bldg., Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Arthur M. Zinkham, 815 Connecticut Ave., Washington.
Secretary: Dr. E. J. Cummings, 1835 I St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, 130 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Hilmar G. Martin, 231 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer. Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6 p. m., second Tuesday of each month.

Minneapolis Ophthalmological Society

Chairman: Each member in alphabetical order.
Secretary: Dr. C. W. Rucker, 527 Medical Arts Bldg., Minneapolis.
Place: Hennepin County Medical Society rooms. Time: 6:30 p. m., fourth Monday of each month, October to May, inclusive.

Montgomery County Medical Society

Chairman: Dr. W. J. Blackburn, 663 Reibold Bldg., Dayton, O.
Secretary-Treasurer: Dr. F. J. Driscoll, 986 Reibold Bldg., Dayton, O.
Place: Van Cleve Hotel. Time: 6:30 p. m., bimonthly, first Tuesday from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. Stuart Ramsay, 1496 Mountain St., Montreal, Canada.
Secretary: Dr. J. Rosenbaum, 1396 St. Catherine St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Kate S. Zerfoss, 119, 7th Ave., N., Nashville, Tenn.
Secretary-Treasurer: Dr. Fowler Hollabaugh, Doctors Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Secretary-Treasurer: Dr. H. F. Brewster, 837 Gravier St., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. John H. Dunnington, 30 W. 59th St., New York.
Secretary: Dr. LaGrand H. Hardy, 30 E. 40th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. W. H. Stokes, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Delbert K. Judd, 1020 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. E. C. Reynolds, 657 Main Ave., Passaic, N. J.
Secretary-Treasurer: Dr. T. A. Sanfacon, 80 Park Ave., Paterson, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Secretary: Dr. Edmund B. Spaeth, 1930 Chestnut St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Glendon E. Curry, Westinghouse Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Falk Clinic. Time: 4 p. m., second Friday of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Robert H. Courtney, Professional Bldg., Richmond, Va.
Secretary: Dr. Richard W. Vaughan, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. R. E. Elliott, 78 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Raphael Farber, 280 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. Carl T. Eber, 308 N. 6th St., St. Louis.
Secretary: Dr. W. M. James, 508 N. Grand Ave., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Secretary: Dr. Louis F. Morrison, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. John T. Crebbin, 624 Travis St., Shreveport, La.
Secretary-Treasurer: Dr. J. A. Wilkinson, Medical Arts Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. A. Veasey Jr., 407 Riverside Ave., Spokane, Wash.
Secretary: Dr. Philip B. Greene, Old National Bank Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. Herbert Katz, 212 Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Samuel Mortimer Lyon, 122 Bloor St., W., Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. James M. Greear Jr., 1740 M St., N. W., Washington, D. C.
Secretary-Treasurer: Dr. Ernest Sheppard, 927 17th St., Washington, D. C.
Place: Episcopal Eye, Ear and Throat Hospital. Time: 8 p. m., first Monday in November, January, March and May.